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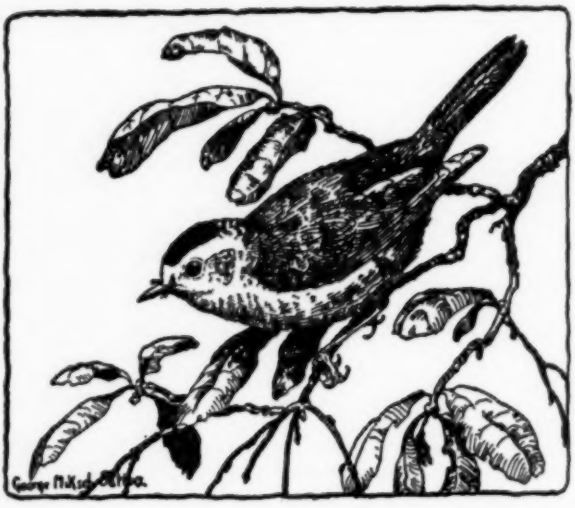

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THE WILSON ORNITHOLOGICAL CLUB

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THE WILSON BULLETIN

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HELP YOURSELF—AND THE WILSON CLUB

The mails these days are filled with appeals for contributions to innumerable philanthropic, educational and scientific institutions. We do not decry this necessary part of modern life—most of the institutions are worthy and there is undeniable satisfaction in helping a worthy cause and in so giving pleasure and benefit to others.

However, we would like to mention an opportunity to contribute to the conservation of our birdlife by supporting an organization active in sustaining interest in and concern for this birdlife, while at the same time benefiting yourself.

We refer to Life Membership in the Wilson Ornithological Club. Life membership contributions are placed in the Endowment Fund. If you are a member of the Wilson Club and especially if you have been a member for some years, it is probable that you derive some, perhaps much, pleasure and benefit from your membership and that you deem the Club worthy of your support. If you belong on an annual basis, you and the Club benefit from your dues as long as you pay them, but when you pass on to study the birds of paradise, your benefit to the Club ceases. Or if, because of adversity of some sort, you can no longer pay dues, both you and the Club cease to benefit. A Life Member, however, not only is spared the annual bother of sending in his dues, but he has also made a financial investment which will pay interest annually and is free from income tax throughout his life. He knows that he will reap the benefits and pleasures of membership as long as he lives. Furthermore, he is aware that the Club has invested the sum he paid and so should continue to receive interest from it long after he is gone. What better example of *mutual* benefit can you find than this?

If the Chairman may be pardoned for twanging a personal string, he will say that long ago when he was young, singularly blessed, and moneyed more than sufficiently for his needs, he showed more wisdom than he has sometimes since by joining for life the W.O.C., the A.O.U., and sundry other organizations, and now that he is *pater familias* and the dollar is not what it used to be, he is very glad he did so. No dues to pay, but still *The Wilson Bulletin* and *The Auk* and the others keep coming! He would like you to be glad, too, so pick up your pen and battered checkbook and assure for yourself and for your Club a bit of that "security" which has become such a shibboleth.

While Life Membership is of *greatest* benefit to younger members, it helps your Club at whatever age you take it out. Besides, don't forget that people are living a lot longer than they used to and life is fun—especially to a Life Member of the W.O.C. with no more worries about paying dues. Try it and see.

The Endowment Committee
Charles H. Rogers, *Chairman*

FIG. 1. Nest and eggs of anhinga at Swan Lake, Arkansas, photographed May 3, 1952. This nest was appropriated from a pair of American Egrets.

FIG. 2. Young anhinga in nest, photographed at Swan Lake, Arkansas, July 4, 1953. Nests constructed by anhingas are usually more compact and of greater depth than those of herons or egrets.

NESTING OF THE WATER-TURKEY IN EASTERN ARKANSAS

BY BROOKE MEANLEY

DURING the nesting seasons of 1951, 1952, and 1953 I had opportunity to obtain certain information relative to the nesting of the Water-Turkey (*Anhinga anhinga leucogaster*), or anhinga, in eastern Arkansas. This was made possible at a nesting colony located on April 10, 1951 while I was driving along the base of the Arkansas River levee at Swan Lake with Robert E. Stewart who spotted several anhingas circling over the brushy end of a small lake. The village of Swan Lake is about fifteen airline miles east of Pine Bluff and is surrounded by the cotton fields of Jefferson County.

I am indebted to Anna Gilkeson Meanley for assistance in several phases of the field work, to Neil Hotchkiss of the U.S. Fish and Wildlife Service for the identification of certain plants mentioned in this paper, and to E. R. Kalmbach of the U. S. Fish and Wildlife Service for reviewing the manuscript.

Status as a Breeding Bird in Arkansas

The breeding range of the anhinga in Arkansas lies largely in the eastern third of the State. Favorite nesting places are about the margins of old river-bed or ox-bow lakes along the lower Arkansas River, lower White River and Mississippi River. Arthur H. Howell (1911:15) has written the following about the occurrence of the anhinga in Arkansas in the early 1900s: "The water turkey or 'snake bird' is fairly common locally in the swamps of eastern Arkansas. It breeds at Helena [on the Mississippi River], Wilmot [southeastern part of state near Louisiana line], and Walker Lake [an ox-bow of the Mississippi in northeastern Arkansas] and has been recorded from Osceola and Newport (northeastern Arkansas) . . ." Baerg (1951:28) lists additional breeding localities as Grassy Lake, Hempstead County, and the White River Heronry, Arkansas County. Nesting localities observed by the writer, in addition to Swan Lake, are Cypress Bayou near Tichnor, and in several rice field reservoirs near Stuttgart.

The Swan Lake Colony

The Swan Lake colony is located at the south end of an old river-bed lake in a large heronry. This lake was a section of the main channel of the Arkansas River over one hundred years ago, and the river in its ever changing course is now three miles away. The heronry is only about 200 yards from the center of the village of Swan Lake. It occupies an area of about 20 acres of button-bush (*Cephalanthus occidentalis*) and swamp privet (*Forestiera acuminata*).

The several species of herons and egrets nesting in this heronry and their estimated numbers (pairs) in 1952 were as follows: Little Blue Heron (*Flori-*

da caerulea) 200, Snowy Egret (*Leucophoyx thula*) 100, American Egret (*Casmerodius albus*) 70, Green Heron (*Butorides virescens*) 15. Passerine birds nesting in the heronry, in order of abundance, were Bronzed Grackle (*Quiscalas quiscula*), Red-winged Blackbird (*Agelaius phoeniceus*), Prothonotary Warbler (*Protonotaria citrea*), and Baltimore Oriole (*Icterus galbula*). During the latter part of May, 1953 a flock of 40 White Ibises (*Guara alba*) came to the heronry at about 5:30 p.m. each evening to roost.

The number of nesting pairs of anhingas ranged between 20 and 25 during the three years of my observations.

Arrival of Migrants

Anhingas usually arrived at Swan Lake during the first or second week in April. Seventy-five miles south, at Wilmot, Arkansas, I have seen them as early as March 21 (1953). In 1952 the first anhinga, a male, was observed at Swan Lake on April 5. By the 15th of the month most of the females had returned and many of the anhingas were paired.

In 1953, probably because of a cold spell beginning in mid-March and lasting through early April, the first arrivals were not observed until April 19, when two pairs were seen. Two days later there were 26 birds (20 males and 6 females) at the heronry.

Herons and egrets usually arrived about two weeks ahead of the anhingas and a few pairs had eggs before the first anhinga put in an appearance.

Courtship and Pairing

In 1952 male anhingas were observed in courtship display on the first day of arrival at the nesting colony. While possibly on their territories they would lift their folded wings alternately up and down above their backs in a sort of flapping motion for several minutes and sometimes point their partly spread tails upwards, nearly vertically, usually ending the performance in a crouch as if molding a nest. As the displaying bird crouched the neck was usually curved in an "S" shape with the bill pointing downward and the feathers on the neck and head extended outward. As the climax of the performance was reached during the crouch a gutteral sound that somewhat resembled the low rolling notes of a screech owl (*Otus asio*) was uttered.

Following this exhibition the head and neck were usually extended straight out from the body and sometimes held motionless for several seconds. The outstretched neck and head were then shifted about in several directions.

When in courtship display the males were not always on their territories. I noticed one male that followed a female from one end of the heronry to the other while performing. I also observed another male displaying in various widely scattered locations throughout the heronry. On one occasion I ob-

served two males perched about three feet apart going through courtship display at the same time and almost in unison.

It appears that in some cases pairing may have occurred before the birds reached the heronry as several pairs had started to build nests two days after arrival in 1953.

Selection of Nests and Nest Building

In the Swan Lake heronry anhingas either appropriated occupied nests of American Egrets, Snowies, and Little Blues or constructed their own. Of 20 nests under observation in 1953 at least 6 were originally nests of egrets or herons. Additional nest-lining material was added to nests taken from egrets and herons.

On April 21, 1953 I saw a mated pair of anhingas perched about two feet away from an incubating American Egret. When I returned on the 23rd they had taken over the nest and the egret was then standing by. The egret and its mate attempted to retake the nest when the anhingas left to copulate several feet away; however, the male anhinga flew at the egrets and they backed off. On no occasion did I see anhingas forcibly eject an American Egret from its nest. They wait for the laying bird to leave and then move in. Also on April 21, 1953 while I was hidden in a blind about 20 feet from an American Egret's nest I noted that when the incubating or laying bird left for a few minutes an anhinga quickly moved in and stood on the rim of the nest. In three minutes the egret returned and alighted about four feet away. It did not attempt to dislodge the anhinga, although it made threatening gestures by pointing its out-stretched neck and head with bill open, emitting gutteral sounds in the direction of the anhinga. The anhinga in turn did the same. As the egret looked on, the anhinga picked up the three eggs one by one from the nest and dropped them over the side into the water.

On May 30, 1953 I observed a pair of anhingas nest hunting. They moved from one occupied Little Blue nest to the next forcing out the incubating or brooding herons as they made their inspection.

On the other side of the picture was the fact that, whenever the opportunity availed itself, egrets and Little Blue Herons removed sticks from anhinga nests for use in the construction of their own. I have seen the entire nest of an anhinga destroyed during the bird's absence by egrets and herons. In many cases as soon as the young anhingas had left their nest it was torn apart by the egrets or herons which used the sticks in constructing or mending their own.

When egret nests are taken over by anhingas, willow (*Salix*) twigs are usually added and the nest becomes a much better constructed affair. Most of the egret nests are made of buttonbush twigs. When the anhinga builds its own nest at Swan Lake, willow branches with foliage are nearly always used.

Such nests are usually smaller and more compact than those of the American Egret.

Apparently the male gathers most if not all of the nest material. On April 25, 1953 I arrived at the heronry at 3:15 p.m.. and saw a male anhinga breaking off leafy twigs or small branches from a willow and carrying them to the female which was sitting on the nest platform. The female would then work the twigs into the nest. During the next hour the male made five trips, four to the same branch of the same tree and one to another tree, in both cases about one hundred feet from the nest. Throughout the time the male was gathering nest material the female remained on the nest. A nest is often started and completed in a single day.

All nests, whether built completely by the anhingas or taken from the egrets, were lined with the leaves and staminate and/or pistillate catkins of willow, a mark that distinguished them from the heron and egret nests. Other distinguishing features were the brown willow twigs, abundance of excreta during the incubation period, particularly on the rim of the nest, and as already mentioned, the compactness of the structure.

In 1952, 16 of 18 nests were in buttonbush, the other two in swamp privet. The ratio was about the same in 1953. In 1952 the average depth of water in the nesting area was three feet. The distance from the surface of the lake to the nests ranged from 3 feet, 7 inches to 10 feet, 7 inches, with an average for 12 nests of approximately 8 feet.

There were several small nesting groups within the heronry. In 1953 the group in the east side was composed of 4 nests. The largest group was in the center of the heronry where there were 11 nests. The nests were fairly close together in each group, in some cases only 6 or 8 feet apart. They were sometimes separated by a heron or egret nest.

Egg Laying and Clutch Size

In 1952 the first eggs were found on April 24, nineteen days after the first male arrived at the heronry, and nine days after arrival of the females. In 1953 egg laying began on April 25, seven days after arrival of the first migrant. In 1952 twelve pairs had complete sets of eggs by April 30.

Bent (1922:232) says that "The eggs are often laid at irregular intervals, as the young in a nest are frequently of widely different ages." In most nests at Swan Lake the young were only two or three days apart in age. In 1953, two nests under observation contained one egg each on May 21. On May 24 both contained only two eggs. On my next visit to the heronry on May 28, one of the nests contained 3 eggs. In 1952 one nest under observation during the egg-laying period contained three eggs on April 30 and five eggs on May 3. In 1953 another nest contained three eggs on May 24, three on May 30, and four on June 6.

Clutch size ranged from two to five eggs. Of 29 nests under observation in 1952 and 1953, 6 contained five eggs, 13 four eggs, 9 three eggs, and 1 two eggs.

Incubation

Both sexes incubate. On April 30, 1952 the female was incubating at a certain nest when I arrived at the colony at 2:30 p.m. When I left at 5:30 p.m. the male was incubating. On May 3 of the same year males were incubating at seven nests and females at four when I arrived at the heronry.

At a certain nest under observation throughout most of the day on three successive Saturdays the female was always incubating. The male was usually perched about eight feet away. On one occasion when the male left its territorial perch and dropped below into the water another male that had been perched 75 feet away from the nest flew over and mounted the female on the nest. The incubating female made no attempt to, or perhaps could not, leave the nest. In a matter of seconds the mated male returned and chased off the intruder.

At two nests, in 1953, the females left for good after the eggs were laid, leaving the males to incubate and care for the young.

Sprunt and Chamberlain (1950:75) give the incubation period as 25 to 28 days. My observations on length of incubation period are not complete. I found this information sometimes difficult to obtain as I could not always determine just when the birds began to incubate. At Nest no. 8 the incubation period for the first of three eggs was probably between 25 and 28 days. The first egg was laid on May 21. By May 24 there were two eggs in the nest and on May 26 there was a full set of three. The first egg hatched on June 20. Nest no. 7 contained two eggs on May 28, three eggs on May 30. There were two newly hatched young in the nest on June 24.

Care and Food of Young

Both sexes brood, feed, and otherwise care for, the young. The young feed by thrusting the bill down the throat of the parent. An interesting photograph by A. M. Bailey and F. R. Dickinson in "The Birdlife of Louisiana" (Oberholser, 1938:pl. 6) illustrates this procedure. Fish appeared to form the principal diet of the Swan Lake young. When I was standing beneath anhinga nests young birds often regurgitated whole fish which fell near me into the water. Several of these fish collected were identified at the Arkansas Game and Fish Commission Hatchery at Lonoke, Arkansas, as small sunfish (*Lepomis* spp.). Stomachs of two approximately week-old young contained mostly fish, a few aquatic beetle (*Dytiscid*) fragments, and rootlets of an aquatic plant.

The adult birds did some fishing in the water beneath the nests, but mostly in nearby bayous, river-bed lakes and in the Arkansas River.

One young bird remained in or near its nest for approximately three weeks after hatching. I arrived at Nest no. 20 at the time of hatching of the first egg on May 30 (the two remaining eggs in the nest were infertile). The young bird began wandering away from the nest after June 20. On June 24 it was observed about 60 feet from the nest climbing about the tops of buttonbushes. It would sometimes flutter several feet from a higher to a lower limb.

After about two weeks of age some of the young would jump out of their nests into the water as I walked beneath them. I observed this action closely to find out if the birds actually dived, but was disappointed to see that they made a perfect "bellyflop." Mr. P. J. Van Huisen, Manager of the White River National Wildlife Refuge, also observed this characteristic flop into the water by the young at Swan Lake when disturbed. After hitting the water the older young would usually swim beneath the surface for several yards and occasionally for a considerable distance before emerging. It seemed remarkable to me that one young bird (and no doubt others a little over two weeks old) was able to return to its nest after jumping into the water from a height of 12 feet. This young bird, one of three in a nest, jumped into the water on a Wednesday and by Saturday had returned, as there were then three birds in the nest.

Nesting Success

Of 20 nests under observation in 1952, only 8 were successful in hatching one or more young, and only 13 young were produced from these nests. The low nesting success was due partially to curious boys and bird photographers, including the writer. Whenever someone entered the heronry the anhingas, egrets, and herons usually left the immediate area of the intrusion with the anhingas the last to return. During their absence the egrets and herons pilfered some nests, carrying the sticks to their own. Many of the eggs "cooked" from the heat of the sun during the anhingas' enforced absence. I picked up several eggs that were almost too hot to handle. The fact that a well travelled farm road was less than fifty yards from several nests may have hindered success in these nests. In 1953 seven of ten nests marked to determine nesting success produced one or more young on the wing, with a total production of 14 young.

Post-Nesting Activity

In 1952 the last anhinga left the Swan Lake heronry on about July 14, but some egrets and herons were still feeding young after that date.

After nesting is concluded, the anhingas move into the bayous, river-bed lakes, "borrow" pits below the river levees, rice field reservoirs, and large

ponds. At a goldfish pond near Swan Lake an anhinga was observed feeding on goldfish for about a week before it was shot. Examination of its stomach revealed six undigested goldfish measuring from three to four inches in length, and some aquatic plant fragments.

Most of the summer resident anhingas leave Arkansas by early October. The latest date of departure noted by the writer was October 17, 1950, when six anhingas were seen with a small flock of White Pelicans (*Pelecanus erythrorhynchos*) soaring and gradually drifting downstream toward the mouth of the Arkansas.

Summary

Information relative to the nesting of the anhinga in eastern Arkansas was obtained by the writer in 1951, 1952, and 1953 when nesting anhingas were studied in a large heronry of mixed species at Swan Lake, Jefferson County.

The breeding range of the anhinga lies largely in the eastern third of the state, and favorite nesting places are about the margins of old river-bed lakes along the lower Arkansas River, Lower White River, and the Mississippi River.

Anhingas arrive at Swan Lake usually during the first or second week in April, and courtship begins almost immediately.

Nests were either constructed by the anhingas or appropriated from herons and egrets, and most were placed in buttonbushes at a height averaging about eight feet from the surface of the water. The male gathered most if not all of the material and the nest was sometimes completed in a single day.

Egg laying began during the last week in April. Of 29 nests, 6 contained five eggs, 13 four eggs, 9 three eggs, and 1 two eggs. Incubation, in which both sexes participate, was probably between 25 and 28 days. The sexes also join in brooding and feeding the young.

Fish was the principal diet of the young, but aquatic plants were also found in two stomachs.

One young bird left its nest about three weeks from time of hatching, but remained nearby (within 20 yards) during the next two weeks. Two week-old young that jumped from their nests when disturbed by the writer were eventually able to return, presumably under their own power.

Nesting success was below normal largely because of interference by human beings. In 1952 eight out of twenty nests produced one or more young. In 1953 seven of ten nests produced one or more young on the wing.

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P. O. BOX 270, U. S. FISH AND WILDLIFE SERVICE, STUTTGART, ARKANSAS, AUGUST 30, 1953

NEW LIFE MEMBER

E. Alexander Bergstrom is an insurance underwriter by trade and a bird-bander by avocation. His station in West Hartford, Connecticut, bands about 2000 individuals a year; special interests include trap design, plantings appropriate for a banding station, and a nearby Bank Swallow banding project (now in its tenth year). Since the fall of 1950, Bergstrom has been editor of *Bird-Banding*, succeeding the late James Lee Peters. He is a member of some two dozen groups interested in birds in particular or natural history in general, including the British Ornithologists' Union, the Hartford Bird Study Club (president), the Linnean Society of New York, the Massachusetts Audubon Society (vice-president), the Northeastern Bird-Banding Association (member of the council), and the Nuttall Ornithological Club. He was born in 1919, graduated from Harvard ('39), and (in 1943) married Elizabeth Wasson, who shares his interest in birds. They have four children.

TRAILL'S FLYCATCHER IN NEW YORK

BY KENNETH C. PARKES

A CONTROVERSY over the subspecific division of Traill's Flycatcher (*Empidonax traillii*) in the eastern portion of its range has existed since Brewster (1895) gave the name *alnorum* to the breeding form of the boreal northeast. Few authors supported Brewster in this division until Aldrich (1951) finally demonstrated that two eastern subspecies are, indeed, recognizable. Aldrich claimed that Brewster had named the wrong population and that Audubon's type specimen of *traillii* was a migrant of the boreal race. Aldrich placed *alnorum* as a synonym of *traillii* and gave the name *campestris* to what he called the "Plains Traill's Flycatcher." Snyder (1953) agreed that two subspecies should be recognized, and defined their respective ranges in greater detail than had Aldrich. Snyder, however, felt that the naming of *campestris* was unnecessary, and preferred to use *alnorum* and *traillii* as originally proposed by Brewster. Nomenclature is outside the scope of the present paper. My notes were assembled before the appearance of Snyder's paper, and use the names *traillii* and *campestris* following Aldrich. For convenience I use the latter nomenclature here; this is not to be construed as an endorsement of Aldrich's findings nor a refutation of those of Snyder.

Much of the interest in Traill's Flycatcher centers on the fact that the two eastern subspecies are barely separable morphologically but are strikingly different in song and habits. These differences have been discussed by Snyder (1953) and Aldrich (1953). McCabe (1951) discussed the question of song, but as pointed out by Allen (1952) and Snyder (1953), several of McCabe's findings are subject to reinterpretation. To summarize the differences between the subspecies, *traillii* builds a bulky, coarse nest not unlike that of a Song Sparrow (*Melospiza melodia*), prefers on the average a wetter habitat, tends to lay heavily spotted eggs, and sings a three-syllabled song accented on the second syllable; the *wee-be-o* of Peterson (1947:152) and many others. On the other hand, *campestris* builds a compact nest much resembling that of a Yellow Warbler (*Dendroica petechia*), frequently lives in drier situations, tends to lay sparsely spotted eggs, and sings a two-syllabled song accented on the first syllable; the *fitz-bew* of Peterson (*loc. cit.*). The objective distinctness of the two songs is well illustrated by the audio-spectrographs of Kellogg and Stein (1953).

Both Snyder (1953) and Aldrich (1953) have discussed these characteristics of the two races with particular emphasis on the portions of the range where only one of the two is found. Both authors have mentioned New York as one of the regions in which *both* subspecies may be found. Aldrich (1953:9) stated: "It is possible that the western prairie population of Traill's

Flycatcher was formerly more completely isolated from the eastern boreal population, but has recently come into closer contact by infiltration from the west, along the plain of the Great Lakes, since removal of the original forest cover has produced more satisfactory habitat for it." Students of bird distribution in New York will recognize this as a well-known route of penetration into the state by species of southern and western affinities. That Aldrich's theory is probably correct is indicated by the discussion of this species in Eaton's "Birds of New York" (1914). Eaton knew the bird chiefly as an inhabitant of the mountains and cold bogs. His description of the song, nest, and eggs leaves little doubt that the bird he knew in New York was the race we now call *traillii*. However, he mentioned that the bird was appearing in the "Transition Zone" of the western part of the state where it had not been previously known. We may postulate that these immigrants were *campestris* moving in from the west.

A number of austral birds have penetrated New York from two directions; from the west along the Lake Plains and from the south entering the lower Hudson valley. This is apparently true of *campestris*. The breeding form of the Adirondack Mountains, most of the Catskill Mountains, and of the "Canadian Zone" islands in central and western New York is definitely *traillii*. The breeding form of the Lake Plains as far east as Oswego is *campestris*. So much has been acknowledged by recent authors. Richard B. Fischer, who has been conducting a study of this species in southeastern New York, has shown that the breeding population of Long Island conforms most closely in song and habits to the type we are calling *campestris* (Fischer, 1950). That this race is penetrating the normal range of *traillii* is indicated by Mr. Fischer's unpublished data concerning the birds breeding in the valleys of the southwestern part of the Catskill region. Birds singing the *fitz-bew* song of *campestris* were found as far north as Lew Beach, in northern Sullivan County. Authentic breeding specimens from southeastern New York are greatly to be desired. It seems almost certain that these birds will prove to be *campestris*, judging from what we know of their song and habits.

It thus seems evident that McCabe (1951) should not have lumped together his New York records of the songs of Traill's Flycatcher. According to McCabe, a questionnaire circulated among the members of the Linnaean Society of New York produced the following interpretations of the song: *fitz-bew*, 11; *wee-be-o*, 3; *greadeal*, 2; *sweet-cheeuu*, 1. Two things are apparent from this listing. First, the members of the Linnaean Society were influenced by their reading in giving their phonetic interpretations, as all of these, letter for letter, have appeared in the literature. Second, twelve of the members learned the song from the southern race, *campestris*, and five from the northern *traillii*. This proportion would not be unexpected, since, as mentioned above, the

campestris song is typical of the breeding birds in the New York City region where the Linnaean Society students are most active.

The situation in western and central New York is more complicated. Aldrich (1953:9–10) stated: "The relatively slight physiographic and ecological barrier which exists today between the Interior Lowlands and Appalachian Plateau physiographic provinces in western New York apparently has been sufficient to prevent complete genetic intermingling of these two populations as indicated by both specimens and field observation of song differences. . . . the correlation of their distribution with the sinuous boundary between plain and plateau results in extremely interdigitated ranges."

There is some evidence that the ecological barrier between these two forms breaks down occasionally, so that reproductive isolation is not complete. This is what we expect to find between subspecies. Snyder (1953:20, footnote) has described a nest which appeared to be of an intermediate type. Both *wee-be-o* and *fitz-bew* birds are to be found in the Finger Lakes region. The latter form, which has increased remarkably in this region in the past few decades (supporting Aldrich's theory of an eastward range extension of the prairie form *campestris*), is an inhabitant of the valley of Cayuga Lake and its tributaries, a generally warmer region than swamps such as that near Danby where the *wee-be-o* type nests. However, correlation of habits and color in this region is not complete. During the course of his revisionary study, Aldrich had at his disposal the excellent series of Traill's Flycatcher from the Cornell University collection. He placed his identifications on the labels of these specimens. Some specimens from the Ithaca region taken in definitely boreal habitats (and which showed other habits of the boreal bird) were identified by Aldrich as *campestris*. Some Ithaca austral birds were labeled *traillii*. One *mated pair* (clearly so stated on labels) was divided between *campestris* and *traillii* by Aldrich. If we assume that color is a constant in these races and color alone is used in identification, then Aldrich's determinations are correct. On this premise it would appear that interbreeding of the two subspecies in the Ithaca region has resulted in some birds with the external appearance of one form and the habits of the other. This would seem to indicate independent segregation of genes governing color, nest-building habits, egg pigmentation, and song (if we assume genetic control of the latter).

Such a recombination of characters should be expected wherever *campestris*, apparently in a dynamic period of range expansion correlated with a general change in cover type and possibly climate, has penetrated the range of *traillii*. There is evidence that this has taken place in northwestern Pennsylvania. Breeding specimens from Crawford County in Carnegie Museum are indistinguishable in color from a long series of undoubted *traillii* from Labrador. Mr. W. E. Clyde Todd tells me that he has never heard a song of this species

in western Pennsylvania that differed from the song heard in the boreal forests of eastern Canada. The two most recently collected sets of eggs of this species in Carnegie Museum were taken in Crawford County in June, 1947. The eggs are heavily spotted like those of *Empidonax virescens*, a characteristic of *E. t. traillii*. They were taken in the same general area as were the skins of *traillii* coloration mentioned above. Yet set no. 4356 bears a note by the collector, R. L. Fricke, to the effect that the nest resembled that of a Yellow Warbler, a characteristic of *campestris!*

There are several other areas where the ranges of *campestris* and *traillii* interdigitate; these are shown by the vertical dashes in Snyder's map (1953: 21). Much can be learned of the interrelationships of these two forms if field students will make careful note of the song, nest construction, egg color and habitat preference of the Traill's Flycatchers in these areas, and supplement this by judicious collecting of *known* breeding birds. This should be done at intervals over as long a period as possible, since *campestris*, as noted above, is apparently in an active period of range expansion.

This paper has been critically read in manuscript by the following ornithologists, to whom I am indebted for much helpful advice as well as for information specifically credited in the body of the paper: John W. Aldrich, Arthur A. Allen, Richard B. Fischer, L. L. Snyder, and W. E. Clyde Todd.

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Carnegie Museum, Pittsburgh, Pennsylvania, August 4, 1953

EFFECTS OF WEATHER ON NOCTURNAL MIGRATION AS SEEN FROM ONE OBSERVATION POINT AT PHILADELPHIA

BY JOSEPH M. DEVLIN

Most bird students are aware that during migration many transient species can be observed in most of the small parks and "squares" scattered throughout the large eastern cities, but many of these places, however interesting, remain unstudied during migrations because of the more varied birding available outside cities. Yet, city oases afford an opportunity to study nocturnal migration in a manner which can not be accomplished in the country. Daytime observations in wooded areas can be misleading, for many night-flying species do a considerable amount of diurnal traveling through the tree tops. Such migrants, with but few exceptions, are rarely seen flying over treeless sections of large cities in the day. When they are first seen in the parks it is almost always at daybreak.

I have for the past several years kept a close vigilance over the small Botany Garden on the campus of the University of Pennsylvania in West Philadelphia. The small area of less than 500 × 500 feet, hemmed in by busy city, is a temporary haven for migrating birds. The place is particularly attractive to migrants because of the varied plantings of both deciduous and evergreen plants and the presence of a pond of approximately one thousand square feet.

When a night migrant comes to the garden, it can usually be discovered almost immediately and watched until it departs. The first appearance of a species in the garden does not necessarily mean first arrival of that species for the Philadelphia region. More often than otherwise, birds arrive in the garden a few days after the species has been reported in the suburbs. The important thing is that we can be reasonably certain that the garden bird was flying over the city in migration on the previous night. We are able to acquire direct evidence of nocturnal migration by training a telescope on the lunar disc, but such observations, as valuable as they may be, produce little data on the kinds (species) that are flying, and peak migrations do not always coincide with the full moon.

Southbound Migration

Southbound nocturnal migration has long been of special interest to me. Working on the premise just outlined, I have correlated autumnal flight with wind direction during the past three years. I found that birds are mostly on the wing on nights with light to moderate north or northwest winds. Since these conditions prevail just after a cold front passes toward the south or southeast over the eastern seaboard, major migrations throughout September

and October are readily predictable. A report of the fall migration of 1952, as seen from West Philadelphia, was published earlier (Devlin, 1953).

Determination of Spring Migrants

In the spring of 1953, I made an effort to correlate northbound night migration with weather conditions. The Botany Garden was examined twice daily, once in the early morning and again in the evening, through 84 consecutive days from March 14 to June 5. I seldom found a new bird in the evening that was not seen on the first survey. Occasionally a flicker was seen flying over city rooftops in daylight, but, because of the timing of the surveys, I feel fairly certain that diurnal migration did not contribute to the counts of flickers reported here.

The second daily survey sometimes showed that some birds had left the garden. These were often birds of timid species and usually happened on balmy days when many people came into the garden. I believe that these birds were actually chased out of the garden in the daytime, so their departure was not considered migration. To avoid confusion migrants were recorded only on arrival.

Migrants were identified as such by the following criteria: 1. all first arrivals; 2. reappearance of a species after an absence; 3. increase in numbers of a species—the difference being counted migrants. Often (by sex, age, distinctive plumage, or peculiarities of song) an individual could be identified for the duration of its stay in the garden. When common species such as the Olive-backed Thrush, Red-eyed Towhee, or White-throated Sparrow were passing through in abundance it was not possible to determine migrants among them, and during such periods these species had to be ignored. Whenever I felt there was any doubt about a bird being a migrant, the bird was not recorded.

Daily meteorological notes were kept, and wind direction was found by releasing hydrogen-filled balloons. Special queries on local conditions were kindly answered by Mr. H. P. Adams of the Philadelphia Weather Bureau. Weather over the entire eastern United States was studied in retrospect from the daily government weather maps.

Birds and the Wind

Soon after this study was started it became apparent to me that the hour just before nightfall was the *critical* time in nocturnal migration. If at that hour the winds were calm or southerly, migration could be expected. It did not seem to matter if the skies were overcast as long as it was not raining. Presumably, migrants took to the sky around dusk. Moon watching showed that when these conditions prevailed throughout the night, birds were in

flight all night and could be watched coming in from the sky soon after daybreak.

When unfavorable conditions for migration, such as heavy fog, rain, or cold north winds, occurred at Philadelphia and southward at the critical hour, there was no migration. If conditions became favorable (south wind, rising temperatures) during the night, there still was no migration. Seemingly, migrants do not often taken flight in the middle of the night.

There were times when weather conditions were unfavorable at Philadelphia but favorable over the region south of us at the critical hour. At such times birds in the south, apparently, were able to take flight, and, if conditions at Philadelphia changed to favorable during the night, the migration penetrated our region. On the basis of the above observations, we were able to predict migration with a high degree of accuracy. Predicting migration was as safe, at least, as forecasting the weather.

In 115 hours of careful searching, I identified 468 birds as nocturnal migrants. 310 of these arrived on southerly winds. 141 were in flight on so-called calm nights. Only 17 birds arrived on northerly winds, and it is interesting that these were early migrants, all of the family Fringillidae.

The word "southerly" as here used means that the entire air mass was moving from any point between east-southeast (clockwise around the compass) to west-southwest. There were 30 nights when the wind was southerly, and migration occurred on 25 of them. On five nights there was no migration; on four of these there were heavy rains throughout the whole region during the critical hour.

Theoretically, a calm night should be best for avian navigation. Nine nights were drawn as calms on the weather maps, and migration occurred on all nine of them. These were all personally investigated, and I found that in every case there was a "breeze" from the south 100 feet above the ground. A wind of 0.5 miles or less per hour is considered a calm. Absolute calms are rare, and if migrating birds should wait for them they might never reach the breeding grounds.

"Northerly" as used here means that the air mass was moving all night from any point between west-northwest (clockwise around the compass) to east-northeast. There were 32 such nights. Migration occurred on only two of them.

Winds were variable from west to northwest on three nights, and there was no evidence of migration.

On one night the winds were variable from east to southeast. Two migrants arrived.

Table 1 gives a list of migrants and the general direction of the winds which

bore them. Migration and weather from May 4 to May 14, inclusive, are presented pictorially in Figures 1 and 2.

TABLE 1

SPRING MIGRANTS AND THE WINDS WHICH BORE THEM

Species	*Wind Direction*		
	Southerly	*Calm*	*Northerly*
Yellow-billed Cuckoo. *Coccyzus americanus.*		2	
Ruby-throated Hummingbird. *Archilochus colubris.*	1		
Yellow-shafted Flicker. *Colaptes auratus.*	10	7	
Yellow-bellied Sapsucker. *Sphyrapicus varius.*	3		
Downy Woodpecker. *Dendrocopos pubescens.*	1		
Phoebe. *Sayornis phoebe.*		2	
Crested Flycatcher. *Myiarchus crinitus.*	3	3	
Traill's Flycatcher. *Empidonax traillii*	1		
Wood Pewee. *Contopus virens.*	2	2	
Brown Creeper. *Certhia familiaris.*	8		
House Wren. *Troglodytes aëdon.*	1		
Catbird. *Dumetella carolinensis.*	15	7	
Brown Thrasher. *Toxostoma rufum.*	2	2	
Wood Thrush. *Hylocichla mustelina.*	1	3	
Hermit Thrush. *Hylocichla guttata.*	5	2	
Olive-backed Thrush. *Hylocichla ustulata.*	4	3	
Gray-cheeked Thrush. *Hylocichla minima.*	1		
Veery. *Hylocichla fuscescens.*	2	1	
Blue-gray Gnatcatcher. *Polioptila caerulea.*	2		
Golden-crowned Kinglet. *Regulus satrapa.*		2	
Ruby-crowned Kinglet. *Regulus calendula.*	3	2	
Yellow-throated Vireo. *Vireo flavifrons.*	1		
Blue-headed Vireo. *Vireo solitarius.*	1	1	
Red-eyed Vireo. *Vireo olivaceus.*	4	2	
Black and White Warbler. *Mniotilta varia.*	2	3	
Blue-winged Warbler. *Vermivora pinus.*		1	
Tennessee Warbler. *Vermivora peregrina.*	1		
Parula Warbler. *Parula americana.*		3	
Yellow Warbler. *Dendroica petechia.*	2	1	
Magnolia Warbler. *Dendroica magnolia.*	6	3	
Black-throated Blue Warbler. *Dendroica caerulescens.*	1	5	
Myrtle Warbler. *Dendroica coronata.*	4	3	
Black-throated Green Warbler. *Dendroica virens.*	1	1	
Chestnut-sided Warbler. *Dendroica pensylvanica.*	3		
Bay-breasted Warbler. *Dendroica castanea.*	2		
Black-poll Warbler. *Dendroica striata.*	8	4	

TABLE 1 (Cont'd)

Prairie Warbler. *Dendroica discolor*	2		
Palm Warbler. *Dendroica palmarum.*	1		
Oven-bird. *Seiurus aurocapillus.*	4		
Northern Water-thrush. *Seiurus noveboracensis.*	1		
Louisiana Water-thrush. *Seiurus motacilla.*	1		
Yellow-throat. *Geothlypis trichas.*	8	3	
Yellow-breasted Chat. *Icteria virens.*	1		
Hooded Warbler. *Wilsonia citrina.*	1		
Wilson's Warbler. *Wilsonia pusilla.*		1	
Canada Warbler. *Wilsonia canadensis.*		2	
Redstart. *Setophaga ruticilla.*	2	7	
Baltimore Oriole. *Icterus galbula.*		2	
Scarlet Tanager. *Piranga olivacea.*	2	1	
Rose-breasted Grosbeak. *Pheucticus ludovicianus.*	1		
Indigo Bunting. *Passerina cyanea.*	1	1	
Purple Finch. *Carpodacus purpureus.*	2		
Red-eyed Towhee. *Pipilo erythrophthalmus.*	8	5	
Slate-colored Junco. *Junco hyemalis.*	86	14	4
Chipping Sparrow. *Spizella passerina.*	20		
Field Sparrow. *Spizella pusilla.*	3	1	1
White-throated Sparrow. *Zonotrichia albicollis.*	59	36	
Fox Sparrow. *Passerella iliaca.*			2
Song Sparrow. *Melospiza melodia.*	6	3	10

MIGRATION AND TEMPERATURES

Some attempt was made to find if there was any correlation between night flight and night temperatures. The problem becomes rather involved because we are dealing with variables such as vertical, linear, and time gradients in temperature. We must also *know* just how high the birds are flying. There still are not enough data, and to publish these would be premature. However, it appears that the Song Sparrow and the Golden-crowned Kinglet initiate nocturnal flight with air temperatures as low as 45°F. and may continue to fly even though the temperature may fall to almost freezing. Most birds probably prefer to fly in higher temperatures, and at Philadelphia after the first of April, winds from the south usually bring with them temperatures of 50°F. or higher. There is no doubt that low temperatures can be limiting, but in spring they seldom are, for southerly winds and mild weather go hand in hand.

South winds in late April sometimes do not bring as many migrants as might be expected. The explanation for this seems to be that by that time most of the early migrants have passed through and the long-distance migrants (mostly warblers) have not yet reached the Atlantic States. One thing

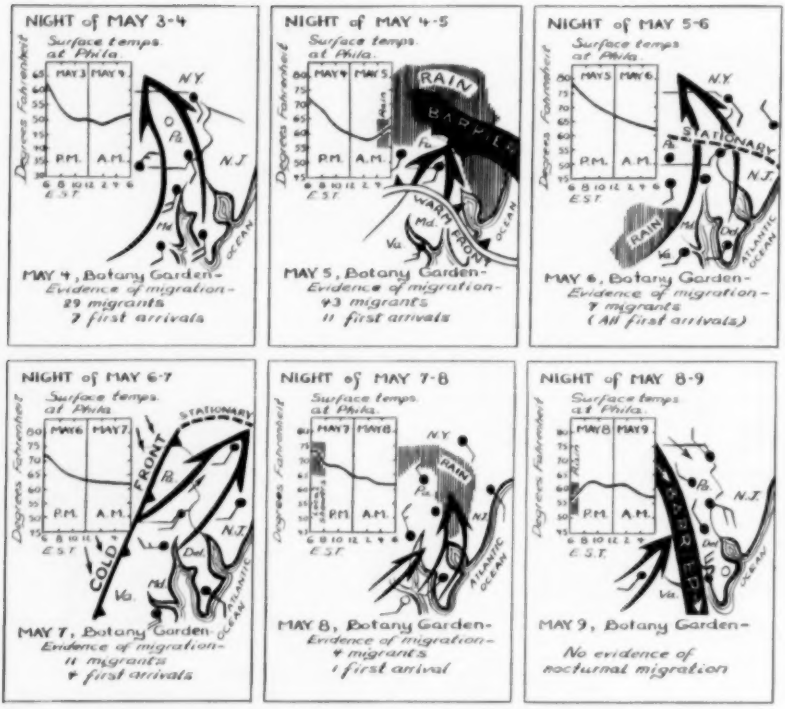

FIG. 1. Weather and nocturnal migration of birds at Philadelphia, May 3 through May 9, 1953. (Key to symbols in Fig. 2)

must be remembered—perfect weather for migration can not bring migrants if the birds have not yet acquired the urge to migrate.

Birding is commonly best during inclement weather, giving rise to the popular belief that birds migrate regardless of the weather. Usually, investigation shows that the birds began their flights before the weather turned unfavorable.

LANDING AT NIGHT

Williams (1950) believes that migrants have difficulty in landing safely on dark nights. He concludes that, even though caught in a thunder storm, they are unwilling to land. This conclusion fits in well with the observations made at the Botany Garden.

On several occasions I was able to focus a telescope on the moon through a hiatus in the thunder clouds immediately after a violent storm. Birds were

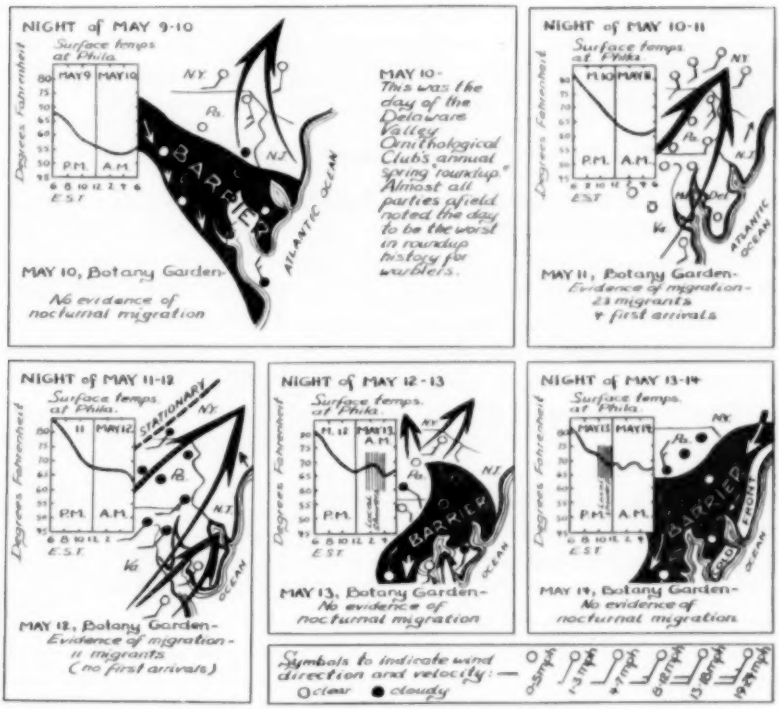

FIG. 2. Weather and nocturnal migration of birds at Philadelphia, May 10 through May 14, 1953.

still aloft. Whether or not they were flying above the storm I am not certain. Only once did I find a water-logged bird (Yellow-bellied Sapsucker) in the garden that I thought was forced to land at night.

In the evening of April 27, the wind was from the southwest and the telescope showed that migration was in full sway. A cold front bringing northwest winds passed through this area during the night, but telescopic observations indicated that the migrants continued to fly on the southerly wind high above the cold front slope. We watched the birds come in from the sky at dawn.

Essentially the same thing happened on the night of May 27-28, when again moon watching revealed that birds were aloft on southerly winds, when northerly winds prevailed at the surface.

In the fall, flying into adverse winds may end in catastrophe. Migrants on

a following wind meeting a warm front with strong southerly winds may be forced to fly very low *under* the frontal slope. Apparently that is what happened on the night of September 21-22, 1953, when 300 migrants crashed to death against the Empire State Building in New York City.

Discussion

The idea that bird migrations proceed according to the weather is by no means new. Thus, the late Wells W. Cooke (1910) noted that in spring "birds prefer migrating in warm weather." However, the concept met with strong disfavor by many top-ranking ornithologists. Wetmore (1927) and others supposed that birds were driven by an irresistible migrational urge to arrive at the breeding grounds by the calendar.

Today the majority of workers believe that weather plays an important rôle in migration. The works of Lowery (1946), Williams (1950), and Imhof (1953) present convincing data which show some of the effects of weather on nocturnal bird flight.

Captain Neil T. McMillan (1938), of Eastern Air Lines, wrote "to a bird on the wing, the wind is a vehicle or means of transportation. It is the air that goes places and the birds go with it." According to Lincoln (1950) and others, the main objection to birds on the wind seems to be that the migrant becomes an object driven hither and thither, *unable to navigate.*

When a mass migration happens on an 18 miles per hour tail wind, it seems inconceivable that birds are guided across magnetic or coriolis fields, or that they can be following landmarks like mountain ranges, rivers, or coast lines. Newman (1952) wrote, "It looks as though migrants tend to travel with the wind toward low pressure areas." Studies at the Botany Garden indicate that night migrants travel with the wind regularly.

How do birds find their way? The most baffling of all questions about migration becomes even more baffling.

Summary

By keeping a close watch for migrants in some small park in a large city one is able to determine the nights of migration. When it is known on what nights birds are in flight, the appropriate correlations with weather can be made. The writer has been interested in this sort of observational research and has used the Botany Garden on the campus of the University of Pennsylvania for the field work.

In the spring of 1953 it was found that the majority of migrants arrived on southerly winds or on temperate calm nights. Relatively few birds came in on nights with northerly winds.

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218 South 43rd St., Philadelphia 4, Pennsylvania, August 7, 1953

NEW LIFE MEMBER

Dale A. Zimmerman was born at Imlay City, Michigan, on June 7, 1928. From early childhood birds have been a major interest for him and his ornithological travels have taken him to many areas from Canada to southern Mexico. He is at present studying for the Ph.D. degree at the University of Michigan, from which he has already received B.S. and M.S. degrees. Although his interests in birds are varied, he has devoted much time to field studies of birds in Michigan and Mexico and to studies of avian distribution in general. Additionally, Zimmerman actively bands, paints, and photographs birds.

METEOROLOGICAL ANALYSIS OF OCCURRENCE OF GROUNDED MIGRANTS AT SMITH POINT, TEXAS, APRIL 17 - MAY 17, 1951

BY JOHN V. DENNIS

It is not at all clear to what extent and in what manner weather controls the migratory movements of birds. Some authorities belittle the influence of weather and place far more emphasis upon such factors as amount of daylight, degree of gonadal development, and inherited migratory urge. Others suppose spring migration to be regulated by the advance of temperature isotherms. Still others disagree with a purely mechanistic approach and believe that day to day changes in the weather play an important role in shaping the progress of migration.

This latter concept is the one favored by most recent writers (Robbins, 1949; Williams, 1950; Bagg *et al.*, 1950; Gunn and Crocker, 1951). Their findings clearly confirm the fact that weather does exert an influence upon migration, and, in many instances, show that birds respond to weather variations to a very marked degree. Not enough detailed studies are available, however, to permit students to say that birds always respond in the same manner to the same meteorological phenomena. As a slight contribution to our knowledge in this field I am now undertaking to interpret daily observations of the spring migration made by myself at Smith Point, Texas, in April and May of 1951.

For their most generous help in reading and analyzing my manuscript I am indebted to W. W. H. Gunn and Aaron M. Bagg.

Study Area and Methods

Smith Point is a triangular shaped area of land which projects into Galveston Bay from the northeastern side. From the area where observations were made near the end of the point, it is 10 miles to the Gulf of Mexico while the metropolis of Galveston on the Gulf lies some 18 miles across the bay to the south. A strip of woods on the north side of the point was chosen as a suitable locality to make daily observations.

The low-lying woods, composed of hackberry, *Celtis* sp., and various xerophytic trees and shrubs, faces the bay to the north and open pasture land to the south. At the eastern end a narrow creek bordered by marshes separates the study area from another similar thicket to the northeast. Surrounded by water or grazing land, the thicket, stretching three-fourths of a mile along the bay and averaging about 50 feet in width, forms a natural haven for migratory land birds.

On April 17, 1951, I began taking census counts at the thicket. With the

exception of April 20, when it was impossible to be in the area, counts were made every day through May 17, 1951. Generally counts were conducted during the morning. No set length of time was prescribed nor was the thicket always traversed in exactly the same manner. When few migrants were present the thicket could be covered in less than an hour, but on certain days when large numbers of birds were present, it took as long as six hours to make a thorough coverage. Owing to dense foliage in places, it was a time-consuming process to make reasonably sure that all species, if not all individuals, were counted. On the whole, birds were easy to approach and it was possible to view them under good conditions for making identifications.

Not included in the counts were resident species and birds not definitely associated with the thicket. Thus the following residents found in the area were not included although migrant individuals, representing several of these species, undoubtedly passed through: Mourning Dove (*Zenaidura macroura*), Scissor-tailed Flycatcher (*Muscivora forficata*), Mockingbird (*Mimus polyglottos*), Red-winged Blackbird (*Agelaius phoeniceus*), Boat-tailed Grackle (*Cassidix mexicanus*), and Cardinal (*Richmondena cardinalis*). Not closely enough associated with the census area to be included were herons, hawks, gulls, terns, shorebirds, and swallows. The Savannah Sparrow (*Passerculus sandwichensis*) and the Dickcissel (*Spiza americana*), although often present in large numbers, were not closely associated with the area and so were not included. The Sora (*Porzana carolina*) on the other hand, was included when found taking refuge within the census area. The Blue-gray Gnatcatcher (*Polioptila caerulea*), a migrant which occurred in fair numbers during the first week or two, was mistakenly omitted.

Daily weather reports were obtained from the U.S. Weather Station at Galveston, and data from these have been used in compiling Table 2. For weather developments on a wide scale, frequent reference was made to the weather maps of the U.S. Weather Bureau. Admittedly there are local variations in the weather between Smith Point and Galveston, but these were not considered to be important enough to alter the conclusions arrived at in this study. My own temperature and barometer readings at Smith Point agree closely with those of the Galveston Weather Station, and no major inconsistencies in regard to wind direction or precipitation were detected.

Census Results

Table 1 gives the names of migrants seen in the census area, their numbers, and the dates on which they occurred.

The 52 species listed are migrants closely associated with the census area. The Wood Pewee, Eastern Kingbird, and Indigo Bunting were present on at least 16 of the 30 days in the study period. The Indigo Bunting was the most abundant species recorded. (Figures of 20 and over are estimates.) Of the

Table 1

Daily Counts in the Census Area, April 17—May 17, 1951

Species	April													May															
	17	18	19	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Sora rail, *Porzana carolina*								1													1									
Yellow-billed cuckoo, *Coccyzus americanus*														1							2	1			2	1				1
Black-billed cuckoo, *Coccyzus erythropthalmus*	1	1																												
Ruby-throated hummingbird, *Archilochus colubris*	1	1	1				1											1		1	6	2	2			1				
Eastern kingbird, *Tyrannus tyrannus*	8	1	1	1		1		2	2					12	3		2	2		10					1	1	2			2
Crested flycatcher, *Myiarchus crinitus*	4													2																
Unidentified empidonax, *Empidonax* sp.			1																		1				1					
Wood pewee, *Contopus virens*	1	1	1	1	1	2								3	10		2	4	2	4	6		2	3	2					
Catbird, *Dumetella carolinensis*	1					2	3							3	3			1				1								
Wood thrush, *Hylocichla mustelina*	1					5												2			2									
Olive-backed thrush, *Hylocichla ustulata*	1					1	1							1			1	2		1	8	1			4					
Gray-cheeked thrush, *Hylocichla minima*																	1	1		1	4									
Veery, *Hylocichla fuscescens*																					1									
Cedar waxwing, *Bombycilla cedrorum*																					1									
White-eyed vireo, *Vireo griseus*	3	3				1									2		1													
Bell's vireo, *Vireo bellii*																		1												
Yellow-throated vireo, *Vireo flavifrons*	1																													
Red-eyed vireo, *Vireo olivaceus*	3	5	3	3	3	3	3								1			1	1		2				2					
Philadelphia vireo, *Vireo philadelphicus*															1						1	1								
Warbling vireo, *Vireo gilvus*																		1												
Black and white warbler, *Mniotilta varia*	7	5	1	1		1									2			4			1	1								
Prothonotary warbler, *Protonotaria citrea*	1	1	1																											
Worm-eating warbler, *Helmitheros vermivorus*	1																													
Golden-winged warbler, *Vermivora chrysoptera*						1												1			1									

	17	18	19	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Tennessee warbler, *Vermivora peregrina*															1			3												
Yellow warbler, *Dendroica petechia*		2													2			2			10	3								
Magnolia warbler, *Dendroica magnolia*						1	1	1							20		1	12	1		2	1		1						
Myrtle warbler, *Dendroica coronata*										1				1	1															
Black-throated green warbler, *Dendroica virens*				1		1									1			4			2	1			1					
Cerulean warbler, *Dendroica cerulea*				1																										
Blackburnian warbler, *Dendroica fusca*															1			5	2	2	2									
Chestnut-sided warbler, *Dendroica pensylvanica*						1								2	2			4	1					1						
Bay-breasted warbler, *Dendroica castanea*										1					4			1	1		1	1							
Black-poll warbler, *Dendroica striata*																					1		1	1						
Ovenbird, *Seiurus aurocapillus*	2					2															2			1						
Northern water-thrush, *Seiurus noveboracensis*									1											1	1									
Louisiana water-thrush, *Seiurus motacilla*						1																								
Kentucky warbler, *Oporornis formosus*						1	1																							
Yellow-throat, *Geothlypis trichas*	2	2	1			3								2	6						1				1					
Yellow-breasted chat, *Icteria virens*	1		1			2											1	1								1				
Hooded warbler, *Wilsonia citrina*	6	1	1	1		4																								
Canada warbler, *Wilsonia canadensis*															1			1						1						
American redstart, *Setophaga ruticilla*	3					5	2		2	1					2		1	4	2		2	1			1					
Orchard oriole, *Icterus spurius*	6	4	5	12	1	5					1				4								2							
Baltimore oriole, *Icterus galbula*			1			2	1								2		1	2												
Scarlet tanager, *Piranga olivacea*		1					1																							
Summer tanager, *Piranga rubra*	2	1				1		1													1		1							
Blue grosbeak, *Guiraca caerulea*						1								2	2										1					
Indigo bunting, *Passerina cyanea*	60	20	17	20	20	40	20	7	7					5	20			20		8	20	4		5	3					
Painted bunting, *Passerina ciris*	1	1				1	2	1			1	1		2																
Lincoln's sparrow, *Melospiza lincolnii*					1																									
Swamp sparrow, *Melospiza georgiana*		1													1															

Table 2

Weather Conditions and Numbers of Migrants During Study Period

Date	Average temperature	Precipitation in inches	Prevailing wind direction	Average wind speed (m.p.h.)	Barometric pressure at 6:00 a.m.	Significant changes in wind and temperature	Numbers of species	Numbers of individuals
April 16*	63	.06	NE	16.7	30.00	Light SE before dawn. 38 MPH NNE at 6:00 a.m. changing to E before dark.	23	117
17	61	0	E	15.0	30.10	Shifting from NE to E during the morning	17	51
18	66	.01	S	9.0	29.88		13	35
19	70	0	SW	12.0	29.82			
20	67	.03	SE	12.3	29.91	A change from SE to ENE at noon	9	41
21	71	0	S	11.3	29.93	A change from SE to ENE at 6:00 a.m.	5	26
22*	75	0	N	11.2	30.01	Shifting from E to NNW during the morning	25	88
23	63	0	NE	12.7	30.21	Shifting from N to ESE during the morning	11	36
24	69	0	SE	13.1	30.11		6	13
25	71	0	SE	14.0	29.97		4	12
26	71	0	SE	12.8	30.06		3	3
27	71	0	SE	12.8	30.09		2	2
28	72	0	SE	12.3	30.08		1	1
29	73	0	SE	15.4	29.88		0	0
30	74	0	SE	21.3	29.75	Wind up to 31 MPH.	9	21
May 1*	71	.12	SE	13.0	29.85	A change from SSE to NNW at 2:00 p.m. Temp. drop from 75 to 65 degrees between 3:00 and 4:00 p.m.	25	104
2	75	0	SE	10.9	30.03		1	3
3	75	0	S	10.6	29.98	Temp. rise of 9 degrees between 5:00 a.m. & 2:00 p.m.	8	9
4	79	0	NW	11.1	29.93	Shifting from SSW to NW before dawn. Maximum temperature of 88 degrees.	24	80
5	76	0	S	11.9	29.95	Shifting from NNE to E during the morning.	8	12
6	74	0	SE	13.3	29.88	Temp. rise of 8 degrees between 5:00 a.m. & 2:00 p.m.	7	18
7*	67	.66	NE	16.5	30.02	Shifting from ESE to NNE before dawn	27	92
8	70	.02	E	17.9	30.02	Shifting from NE to E before dawn	12	18
9	75	0	SE	14.3	29.98		5	8
10	74	.21	S	10.5	30.01	A change from SE to NW at 6:00 a.m.	7	13
11*	70	.13	NE	11.0	29.95	Shifting from W to NNE before dawn Shifting from NNE to ESE in afternoon	11	19
12	72	0	E	16.5	29.94	Shifting from NNE to ENE before dawn Shifting from ENE to ESE during afternoon	4	4
13	74	0	E	18.7	29.99		1	2
14	75	0	SE	21.0	30.05	Wind up to 36 MPH.	0	0
15	76	0	SE	23.0	30.10	Wind up to 33 MPH.	0	0
16	75	0	SE	17.9	30.16		2	3
17	75	0	SE	15.8	30.01			

* Cold fronts penetrated region.

warblers the Magnolia occurred in largest numbers, but the American Redstart was present on more days. Warblers and vireos are well represented in the counts by total species if not number of individuals. In comparison the sparrows are rather poorly represented. Absent or poorly represented are several early migrants. The Eastern Phoebe (*Sayornis phoebe*) was not recorded while the Myrtle Warbler was seen only three times. Also a number of migrants were recorded elsewhere in the Smith Point region during the study period but were not seen in the census area; among these are the Yellow-throated Warbler (*Dendroica dominica*) and the Pine Warbler (*Dendroica pinus*).

Table 2 shows several cause and effect relationships existing between number of migrants and weather conditions.

Cold fronts penetrated the region on April 16, and 22, May 1, 7, and 11. The arrival of a cold front is associated with northerly winds, lower temperature, higher barometric pressure, and, on four out of five occasions in my study, precipitation. The only increase in number of migrants not coincident with a cold front occurred on May 4. The significant weather conditions prevailing then were above-average temperature, westerly winds, and relatively low barometric pressure.

It is to be noted that migrants were *not* present in maximum numbers until the day after unfavorable weather had halted migration. After a peak had been reached, numbers declined steadily on each succeeding day of favorable weather. During the last week in April, a period of warm weather and southeasterly winds, the number of migrants declined on each day until on the 30th none at all were recorded.

A cold front on May 11 produced fewer migrants than usual. Presumably this was due to the fact that the peak of migration had passed.

Discussion

Arrival of migrants.—Unfavorable weather conditions may halt migration and result, in the terminology of Bagg, *et al.* (1950), in the presence of an "arrested wave." The opposite of this is an "onrushing wave" which occurs when birds begin moving with a return to weather conditions favorable for migration. At Smith Point, two contrasting meteorological phenomena were seen to result in arrested waves. Of six arrested waves noted during the period of observation, five occurred with the arrival of cold fronts and the sixth seemed to have been caused by a westerly wind.

Several Gulf Coast observers (Williams, 1945; Lowery, 1946) have commented upon the sudden and immediate appearance of migrants with the arrival of a cold front. At Smith Point the arrival of a cold front did not necessarily mean an immediate influx of migrants. Birds would arrive with the

first drop in temperature, but maximum numbers were not present until after the cold front had passed. Thus birds first arrive under weather conditions associated with a cold front. They continue to arrive with rising barometric pressure, warmer temperatures, and the first shift to a southerly wind.

That it takes as long as 24 hours or more for maximum numbers to appear following the arrival of a cold front seems explainable on the grounds that to the south conditions may still be favorable for migration, and thus birds flying over water or along the coast may continue northward even after a cold front has reached the vicinity of Smith Point. As they reach Smith Point, they tend to pile up in coastal thickets. As the coastline is largely devoid of habitat suitable for their needs, it seems likely that birds grounded in this inhospitable region tend to drift northward to wooded areas. Indeed, migrants at the census area, while awaiting favorable weather, restlessly made their way back and forth through the thicket, and some, usually after hesitation, crossed the creek at the eastern end of the thicket and flew to other patches of woods to the north. The creek seemed to act as a barrier, however, and tended to keep birds within the confines of the census area.

It was impossible to tell how long individuals stayed in the area, but there was evidence that some birds stayed as long as three or four days. A single Black-poll Warbler, a rarity along the Texas coast, was counted on three out of four days during the period, May 8 through 11. A Prothonotary Warbler, a species infrequently met with during the period of study, was seen on April 17, 18, and 19. A Philadelphia Vireo, perhaps the same individual, was seen on May 8 and 9.

Winds were from the northeast on four of the five occasions when cold fronts reached the Smith Point region. On May 1, a cold front brought northwesterly winds. The arrival of this cold front was of particular interest because it was in reality a quasi-stationary front which barely penetrated the Galveston Bay region. Immediately to the south a warm front was moving inland along the Texas Coast. On the morning of May 1, when a count was taken in the census area, the cold air-mass had not yet reached Smith Point. Only two migrant species were found, two Painted Buntings and one Myrtle Warbler. The temperature was 75° F., and the wind was from the southeast. At 2:00 p.m. the skies became overcast and the wind shifted to the northwest. Between 3:00 and 4:00 p.m., the Galveston Weather Station recorded a 10° drop in temperature. A fine rain accompanied these changes. I was in a wooded area some 10 miles north of the census area when the first indications of a change in weather became apparent. Migrants began to appear in the woods concurrently with overcast skies, northerly winds and falling temperature. On returning to the census area at 6:00 p.m., I found dozens of birds where in the morning there had been virtually none. Due to poor light

I had difficulty in identifying most of them, but I succeeded in adding seven species to the day's list. Late in the evening the wind shifted back to the southeast and by midnight the temperature had risen seven degrees. But as a result of this brief penetration of a cold air-mass, 25 migrant species were counted in the census area the following morning.

A Black-poll Warbler on May 8 is of interest since Williams (1950) associates the appearance of either this species or the Cape May Warbler (*Dendroica tigrina*) along the Texas coast with northeasterly winds. According to his view they are blown off course from their usual migration route through Florida. Weather conditions on the 8th seem to substantiate this explanation since on that date easterly winds prevailed all along the coast from Florida to Texas.

Arrested waves were associated not only with cold fronts but also, on one occasion (May 4-5), with a period of westerly and northwesterly winds not directly related to a cold front. It is to be noticed (see Table 2) that of six waves reaching Smith Point during the period of study, five were associated with cold fronts and the sixth, on May 5, was in no way associated with a cold front, but followed a period of westerly and northwesterly winds on May 4. The average temperature at Galveston on this date was 79° F., the highest for any day in the study period. Barometric pressure was low in the Galveston region, while the daily weather map for the 4th shows a high pressure area off the Texas coast.

In the events of May 4, we see an exception to the usual sequence of spring migration along the Gulf Coast of Texas. Instead of prevailing southeasterly winds, interrupted on the average of once every six days by the arrival of a cold front, we have westerly winds accompanied by unseasonably warm weather. That migrants should halt in the face of warm weather seems strange, but it appears in this instance that the wind was the controlling factor. With the wind striking them on their port beam, they were in danger, if they continued their flight, of being blown out over the Gulf.

Southwesterly winds on April 19, on the other hand, did not appear to bring a significant number of new migrants into the area. But in view of the fact that 13 species of migrants were counted on that date, it would seem that weather conditions were retarding departures. Ordinarily the exodus of migrants should have been all but completed three days after the passage of a cold front (on April 16). Unfortunately it was not possible for me to make a count on the 20th. If the southwesterly wind had been responsible for grounding an appreciable number of migrants, it might have been revealed by a census on that date.

Departure of migrants.—On departure, wind direction, temperature, and pressure trends are the reverse of conditions prevailing at the time of arrival.

Departures were made, as a rule, under conditions of southerly winds, rising temperature, and falling barometer. The only exceptions were (1) an occasion on May 13, when departures occurred with a rising barometer, and (2) on May 6, following an arrested wave which resulted from westerly winds when departures occurred with lower average daily temperatures.

Rising temperature seems to be the major factor in hastening departure so long as the wind is in a favorable quarter. Bagg *et al.* (1950) speak of "significant temperature-rise and a southerly wind as the meteorological key to the onrushing wave" during spring migration.

Tail winds.—It so happens that southerly winds go hand in hand with rising temperature and, therefore, birds generally leave in spring when a tail wind is blowing. This is in contrast to the behavior of resident species which almost invariably fly directly into the wind or else quarter into the wind when it is strong. When a moderately strong southeast wind was blowing on April 30, 1951, resident birds, without exception, were seen to avoid flying with the wind. On that date the Galveston weather station recorded a southeast wind with an average velocity of 21 m.p.h. A flock of White-faced Glossy Ibises, (*Plegadis mexicana*) was seen flying just above the waves out over Galveston Bay, and directly into the wind. Another flock of the same species flew parallel to the coast and at right angles to the wind.

It is probable that in cases such as the ones cited, birds near large bodies of water avoid flying with a wind which might take them out over a body of water. Similarly migrants, as seen in arrested waves in the face of westerly winds, avoid making flights when there is danger of their being blown out over water. With southeasterly winds migrants face no danger of being blown out over extensive bodies of water, and apparently obtain a distinct advantage in flying with the wind.

It is not clear, however, whether strong tail winds interfere with migration. But in view of the almost complete absence of migrants in the census area at Smith Point when southeast winds of up to 30 m.p.h. were blowing, it is safe to say that strong tail winds along the coast do not result in precipitations of migrants such as occur when a norther strikes. This is either because the birds continue on their course in spite of strong tail winds, or else because birds are simply not overhead to be grounded by adverse conditions. It does seem logical to suppose that continued strong southeasterly winds would tend to push the main current of migration inland.

Summary and Conclusions

From April 17 through May 17, 1951, daily census counts were taken in a thicket at Smith Point, Texas, with the purpose in view of determining how migrating birds respond to changes in weather conditions. During this period

birds were grounded in sizable numbers on six occasions. On five of these occasions the arrival of migrants coincided with the arrival of cold fronts. In the remaining instance a westerly wind was blowing. The following correlations between weather and migration were found to exist:

1. The arrival of a cold front invariably results in an arrested wave.
2. With the arrival of a cold front, migrants temporarily terminate their migration in the face of northerly winds, falling temperature, and rising barometric pressure.
3. The influx of migrants with the advent of a cold front is not immediate. Birds are present in maximum numbers on the day following the arrival of a cold front.
4. Southerly winds, rising temperature, and falling barometric pressure generally attend the departure of migrants.
5. In one instance westerly winds, which might tend to blow migrating birds out over the Gulf, had the same effect in pinning down migrants as the arrival of cold fronts.
6. Migrating birds were not seen to terminate their flight in the presence of strong tail winds.

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Box 376, Leesburg, Virginia, May 4, 1953

BODY WEIGHT AND FAT DEPOSITION IN CAPTIVE WHITE-THROATED SPARROWS IN RELATION TO THE MECHANICS OF MIGRATION[1]

BY ALBERT WOLFSON

In 1945 a study of body weight and fat deposition in transient birds was begun at Evanston, Illinois. The data for the White-throated Sparrow (*Zonotrichia albicollis*) for the years 1945-1947 have been analyzed and are in press (Wolfson, 1954). It was found that White-throats captured in the spring at Evanston varied greatly in body weight and that these variations were correlated with the amount of fat deposition. When the birds were classified according to fat deposition there were significant differences in the mean body weights of the four fat classes (none, little, medium, and heavy). The fact that birds arrived with different amounts of fat suggested that they had had different migratory behavior patterns during the 24 hours prior to capture. Those without fat (mean weight—22.9 gms.) possibly *had undertaken* a long flight the previous night which had brought them to Evanston on the date of capture. Those with "heavy" fat (mean weight—30.3 gms.) were thought to have been feeding in or near Evanston for the past several days and perhaps were "ready" *to undertake* a long flight at night. Irrespective of the interpretations, the marked difference in the body weight and fat deposition of these two groups of birds suggested that their behavior subsequent to arrival at Evanston would be different. On the basis of previous experimental studies (Wolfson, 1942, 1945), the birds without fat would be expected to remain "stationary" and restore their fat deposits. Those with heavy deposits would be expected to undertake a long flight as soon as other conditions were suitable.

The migratory behavior of transients can be studied by noting the length of stop-over time in a given locality and the number of birds which repeat during the migratory period. Two extensive studies of this kind have been made: Stack and Harned (1944) showed that the average stop-over time at Lansing, Michigan, was 4.5 $\pm$1.6 days. Borror (1948) found the stop-over time at Columbus, Ohio, to be 5.3 $\pm$ .3 days. At Columbus, the average percentage of repeats was 48.5. At Lansing, it was 24.0. These data would be more meaningful if we knew the body weight and fat deposition of the birds which were trapped only once, and the entire weight history of those which repeated. Judging from our earlier studies, I would guess that repeaters are primarily birds that arrive with little or no fat. Non-repeaters are probably birds with moderate or large amounts of stored fat. To determine the facts

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entails only recording of the body weight and fat deposition in banded and free-living transients. So far this has not been done by others, and we did not do it in our study. A major weakness of this method is that one may fail to retrap the "repeats" at the proper times. This would prevent a correct evaluation of body weight and fat deposits in relation to subsequent migratory behavior. For example, one may have several weight records which show a gradual decrease in weight for a repeating individual before it disappears from an area. One has no way of knowing whether this individual is foraging a short distance away, or whether it has undertaken a long migratory flight. To overcome this weakness it was decided to retain the birds in captivity after their initial capture and weigh them regularly. In this way the *potential response* of each individual could be determined. I say potential response, because conditions in captivity are far from identical with those in nature. It will remain for studies of free-living birds to determine what actually occurs in nature, but studies of captive birds can yield important clues. I would expect the observations in nature and those in the laboratory to be in agreement conceptually. Differences in degree, if they are found, will probably be readily explicable in terms of the conditions of observation.

The purpose of our study, therefore, was to determine the "weight" and "fat" response of spring transients which arrive with different body weights and amounts of fat. It was thought that a knowledge of these responses would be useful in understanding the migratory behavior of transients. A secondary objective was to compare the data on body weight for the various fat classes in these captive birds with the same data for birds captured in nature. This would give some idea of any degree of difference which might be due to diet or continual availability of food in captivity. Data were obtained in 1946 and 1947.

Methods

The methods of trapping, weighing, and classifying the birds according to age and fat deposits have already been described (Wolfson, 1954). In captivity the birds were housed in flight cages (24 × 15 × 19 inches, or 18 × 18 × 16 inches) which were kept in a large, unheated room. Light was provided by natural daylight. Four to six birds were housed in each cage. Food consisted of unmixed canary seed, dried insects, and dog food, and was available at all times. Water, cuttlebone, and grit were also available at all times.

Results

The first determinations which were made were the changes in mean body weight from the time of capture until the termination of the period of captivity on June 26 and 27. This was done to permit comparisons with the data of

TABLE 1

COMPARISON OF MEAN BODY WEIGHTS OF CAPTIVE BIRDS FOR SUCCESSIVE DATES, 1946–1947. NO SEGREGATION ACCORDING TO SEX, AGE, OR FAT CLASS.

	1946			1947		
	Mean Body Wt.	% change from preceding Wt.	% change from initial Wt.	Mean Body Wt.	% change from preceding Wt.	% change from initial Wt.
Initial Weight	27.8 (20)	—	—	26.6 (29)	—	—
May 7–10	——	—	—	26.7 (4)*	+ .4	+ .4
May 13–19	27.5 (20)	–1.1	–1.1	27.9 (10)*	+4.5	+4.9
May 23	27.3 (20)	– .9	–1.9	——	—	—
May 30	26.0 (20)	–4.7	–6.5	——	—	—
June 4	25.8 (20)	– .8	–7.3	——	—	—
June 11–13	24.8 (20)	–3.9 –9.8**	–10.9	24.7 (22)	–11.5	–7.1
June 26–27	22.3 (20)	–10.1	–17.7	22.6 (20)	–8.5	–15.1

*Data from None and Heavy fat classes only.

**Percentage from May 13–19 for comparison with similar period in 1947.

other investigators, and to test again the value of mean body weight determinations. In our first report (1954) it was shown that mean body weight determinations were of little value in themselves and tended to mask or distort important information. The data are presented in Table 1. The initial weight is the mean body weight at the time of capture for all of the individuals which were subsequently held in captivity. This is followed by the mean body weight for the periods of time or the dates given. From the time of capture, there were relatively small changes in weight until June 11–13. In June the mean body weights decreased markedly. The final mean weights and the percentage lost from the initial weight are almost identical for the two years. This pattern of weight change is what Baldwin and Kendeigh (1938) have shown to be true for many species. The weaknesses of mean body weight determination have been pointed out before and it will become evident that these same weaknesses are applicable here.

In view of the marked variations in body weight and fat deposition on arrival the changes in body weight were analyzed for each of the fat classes. The data for 1946 were more complete and suitable for this purpose, and they are summarized in Figure 1. Using the initial mean body weight as 100%, the percentage change is shown for each date of weighing for each fat class. The marked difference in response between the birds that were initially in the "heavy" and "none" fat classes is evident. By May 16 the birds in the "heavy" fat class had lost about 8% of their weight while the bird in the "none" class had gained about 15%. Unfortunately, only one bird was in the "none" class and four in the "heavy" class so that the quantitative aspects of these responses are open to question. They are also open to question because

sex and age differences are not taken into account in this analysis. Nevertheless the pattern of response is consistent. Birds with "little" fat also gained weight. The birds in the "medium" class remained about the same. It is interesting to note that after the bird in the "none" class reached a maximum weight it began to lose weight just as the "heavy" birds did previously. It is also noteworthy, despite the weakness of the quantitative aspects of this analysis, that the "heavy" birds lost about 25% of their initial weight and the "none" bird lost about 22% of its *maximum* weight.

In view of the fact that "mean" figures tend to obscure the extent of response in individuals, especially in a group where the variations in time of response can occur, Table 2 was prepared. It shows the change in body weight and fat deposition for each individual of each fat class. The marked changes in certain individuals on a given date and the absence of any change in others is clearly evident. The variations in each group are also evident and emphasize the need for more data to determine the quantitative aspects with accuracy. In 1947, the dates of capture were too late and too irregular to permit comparison with the data for 1946.

To satisfy the secondary objective of the study—to compare wild and captive birds with respect to body weight and fat deposition—the mean body weights were calculated for each of the fat classes and are presented for both years in Table 3. The means and percentage change from the "none" class for each year are similar. The data for the captive birds are compared with the wild birds in Table 4. Birds in the wild are slightly heavier than those in captivity in all fat classes, but the differences are too small to be significant.

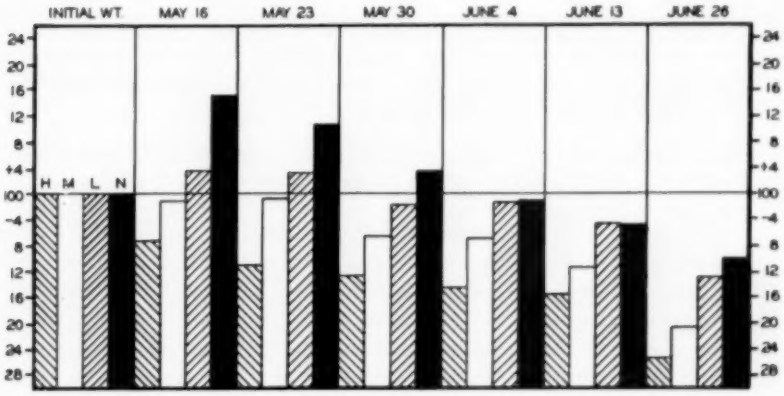

FIG. 1. Percentage change in mean body weight from initial weight for each of the fat classes in 1946. Abbreviations H, M, L, N, refer to fat classes. See text for further explanation.

TABLE 2

BODY WEIGHT AND FAT CLASS OF CAPTIVE BIRDS, SEGREGATED ACCORDING TO FAT DETERMINATION ON DATE OF CAPTURE, 1946*

No.	Age	Cage No.	Date of Capture	Weights on Various Dates					
				May 16	May 23	May 30	June 4	June 13	June 26
				HEAVY					
83	Ad.	2	(14) 31.0–H	29.1–M	25.0–M	24.7–L	23.7–L	24.7–M	22.2–N
91	Ad.	9	(14) 31.6–H	28.4–M	27.0–M	26.6–L	27.0–L	26.3–L	24.3–N
64	Int.	10	(9) 32.2–H	30.5–H	31.0–H	29.1–H	28.5–H	27.5–M	24.0–L
80	Imm.	5	(11) 30.0–H	27.5–M	27.4–M	28.6–M	27.7–M	26.7–M	22.4–N
				MEDIUM					
73	Ad.	9	(11) 31.1–M	29.5–M	31.5–H	29.8–H	31.4–H	29.5–H	27.6–M
77	Ad.	9	(11) 26.2–M	24.7–M	24.3–M	22.9–L	23.7–L	22.4–N	21.2–N
78	Ad.	9	(11) 29.6–M	29.7–M	29.7–M	26.0–L	27.9–L	27.0–L	22.6–N
85	Ad.	6	(14) 28.2–M	27.0–L	26.5–L	25.2–N	25.4–N	26.6–L	22.5–N
88	Ad.	2	(14) 28.1–M	27.6–M	26.3–M	26.0–M	24.2–M	23.2–M	20.1–N
69	Int.	8	(9) 29.7–M	30.5–M	32.0–H	27.1–M	28.1–M	27.7–M	23.3–N
70	Int.	8	(9) 23.3–M	23.0–M	22.8–M	21.4–L	21.5–N	20.0–N	18.9–N
71	Int.	10	(9) 28.5–M	30.0–H	29.2–H	25.7–M	25.8–M	25.4–M	23.8–N
90	Int.	5	(11) 27.3–M	26.2–M	27.5–M	28.8–M	27.4–M	25.0–M	22.7–N
75	Imm.	6	(11) 26.1–M	27.0–M	28.0–H	27.8–H	25.6–M	22.3–L	20.8–N
79	Imm.	6	(11) 26.1–M	24.9–M	24.1–M	23.8–M	22.2–L	20.0–N	18.0–N
				LITTLE					
65	Ad.	10	(9) 23.5–L	24.5–M	26.0–M	25.3–M	25.1–M	24.6–M	23.2–L
74	Ad.	9	(11) 26.9–L	25.5–L	24.7–M	23.8–L	25.4–M	23.2–L	21.6–N
67	Int.	8	(9) 26.6–L	28.1–M	28.1–M	26.9–M	26.0–M	27.3–M	23.3–N
72	Imm.	8	(9) 24.6–L	27.0–M	26.0–M	23.8–L	23.7–L	21.9–L	20.1–N
				NONE					
62	Int.	10	(9) 25.8–N	29.7–M	28.5–M	26.7–L	25.5–L	24.6–L	23.2–N

*The number in the first column represents the last two digits of the band number, the complete number for the series of bands being *40–134100*. The number in parenthesis preceding the weight in the date of capture column is the exact day of capture in May. The letter following each weight indicates the fat class.

To put it another way, the mean weight of captive birds can be expected to be 95 to 97 per cent of the mean weight of wild birds for the same fat class.

DISCUSSION AND CONCLUSIONS

There is good agreement between captive birds and wild birds with respect to maximum and minimum weights. White-throats arriving in Evanston without fat have a mean weight of 22.9 grams. The lowest mean weight reached in captivity was 21.8. The maximum mean weight (on day of capture) for wild birds was 30.3 grams; for birds in captivity it was 29.5 grams. This agreement in wild and captive birds gives us a fairly good idea of the maximum range of variation which we can expect in the White-throated Sparrow. The data from the captive birds seem to strengthen the interpretation made earlier

(Wolfson: 1954) that a White-throat has a maximum of about 8 grams of "metabolizable tissue" which could be used to provide energy for sustained flights. If all of this were fat, an energy source of about 72 Calories would be available. Considering that the daily needs of a White-throat are about 18 Calories a day at 22°C and for a 15-hour photoperiod (Siebert, 1949), one gains some idea of the relative amount of energy available for a single flight at night.

The agreement in captive and wild birds of the mean weights of the fat classes substantiates our classification of birds according to their fat deposits, and confirms the existence of these "classes" in the White-throated Sparrow. It also suggests that the data obtained from captive birds are representative of what occurs in nature. The use of captive birds in ornithological studies is not only permissible, but could well be encouraged in view of the difficulty in making certain studies in the field. I do not suggest that laboratory studies replace field studies, but that they substitute for them when necessary, and

TABLE 3*

MEAN BODY WEIGHTS OF FAT CLASSES IN CAPTIVE BIRDS, 1946–1947

			Fat Class			
			Heavy	Medium	Little	None
Mean body weight	1947	M	29.23 (24)	25.81 (18)	24.85 (10)	21.26 (20)
		E	25.2 – 32.7	22.2 – 30.0	20.2 – 29.0	18.8 – 26.3
	1946	M	29.82 (25)	26.61 (85)	24.77 (53)	22.11 (42)
		E	26.4 – 32.7	22.8 – 30.5	21.4 – 27.9	18.0 – 26.9
	Both yrs.	M	29.5 (49)	26.5 (103)	24.8 (63)	21.8 (62)
Percentage increase from None class	1947		37.5	21.4	16.9	—
	1946		34.9	20.4	12.0	—
	Both yrs.		35.3	21.5	13.8	—
Percentage increase from lower preceding fat class	1947		13.3	3.9	16.9	—
	1946		12.1	7.4	12.0	—
	Both yrs.		11.3	6.8	13.8	—

TABLE 4*

COMPARISON OF MEAN BODY WEIGHTS OF FAT CLASSES IN WILD AND CAPTIVE BIRDS

		Fat Class			
		Heavy	Medium	Little	None
Mean body weight	Wild	30.3 (38)	27.2 (26)	25.7 (27)	22.9 (15)
	Capt.	29.5 (49)	26.5 (103)	24.8 (63)	21.8 (62)
Percentage increase from None class	Wild	32.5	18.8	12.1	—
	Capt.	35.3	21.5	13.8	—
Percentage increase from lower preceding class	Wild	11.5	6.0	12.1	—
	Capt.	11.3	6.8	13.8	—
Body weight of captive birds in relation to wild birds — in percentage		97.0	97.4	96.5	95.2

*In tables 3 and 4, M=mean, E=extremes, numbers in parentheses following weights indicate numbers of birds.

supplement them whenever possible.

The difference in response of the birds in the various fat classes during the first week in captivity suggests that a difference in migratory behavior might be expected in free-living birds. Birds without fat or with "little" fat may stop-over in an area for 4-5 days to replenish their "fuel" before their next major flight. Those with "heavy" and "medium" deposits of fat may be ready to undertake a major flight and will leave an area perhaps after being trapped once. The length of the average stop-over time (4–5 days) and the time it takes to deposit a "medium" or "heavy" amount of fat (4–6 days) are in close agreement. Judging from the condition on arrival, however, it is evident that a bird may not stay in a restricted area and "repeat" there until it achieves a "heavy" deposition of fat. It may move away after restoring its base weight (about 26.0 grams) or putting on some fat, and, hence, arrive at another trapping station with a "medium" or "heavy" amount of fat and without having "migrated" the night before. It would not be difficult for banders to study stop-over time, as has been done, and *add* observations on body weight and fat deposition.

Many more data are needed to determine the migratory behavior of transients, but the combination of studies of body weight and fat deposition in wild and captive birds shows promise of bringing us closer to an understanding of the mechanics of migration. In the last analysis, the problem of the mechanics of migration is a problem in ecology, behavior, and physiology, and many data from each of these fields will be needed to solve it.

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Department of Biological Sciences, Northwestern University, Evanston, Illinois, August 5, 1953

THE PTERYLOSIS OF THE NESTLING *COUA RUFICEPS*

BY ANDREW J. BERGER AND WILLIAM A. LUNK

It seems likely that differences in the pattern of the major feather tracts will be found of considerable importance in determining relationships within the order Cuculiformes. Berger (1953) recently described the pterylosis of an adult specimen of the Blue Coua (*Coua caerulea*). We are now able to describe the pterylosis of the nestling of another species, *C. ruficeps*, of this interesting genus. We are indebted to Dr. Renaud Paulian, Institut Scientifique de Madagascar at Tananarive, for his kindness in sending two sibling nestlings. These birds were taken from a nest near Ifotaka, Lower Mandrare, Madagascar.

Terminology of feather tracts follows that of Burt (1929).

Ventral tract. Marginal apteria (=submalar apteria) are present on each side of the inter-ramal tract. The *ventral cervical feather tract* is undivided anteriorly, but bifurcates about a third of the way down the neck. At the junction of neck and thorax, there is on each side a single row of feathers extending laterad to the ventral marginal coverts. Just anterior to this, another row (single at first) extends dorsad, then laterad, widening to become confluent with the anterior end of the humeral tract. (This row, being lateral in position, could not be clearly indicated in either the dorsal or the ventral view.) There is a wide lateral cervical apterium which is continuous posteriorly with the dorsally located interscapular apterium. Near the anterior end of the sternum, the ventral tract of each side bifurcates to form two *abdominal tracts.* The *inner abdominal tract* is composed of two rows of feathers throughout the sternal and anterior abdominal regions, and continues as a single row which stops short of the anus. The *outer abdominal tract*, also composed of a double row of feathers anteriorly and a single row posteriorly, does not turn inward to join the inner abdominal tract, but ends less than halfway between the posterior margin of the sternum and the anus. The lateral abdominal region is devoid of feathers. There is no anal circlet of feathers.

Capital tract. A very small median frontal apterium is present. There are small superciliary apteria; and between them there is a continuous feather tract in the frontal, coronal, and occipital regions, but the feathers are more widely spaced in the temporal and lateral occipital regions. Well developed eye-lashes are present on both eyelids, those on the upper lids being longer. There is a limited, pigmented, bare area around the eye in the superciliary, subocular, and postocular regions; in the latter the bare area extends only a short distance posterior to the bony orbital rim. The *spinal cervical feather tract*, broadest at the base of the skull, ends abruptly at about the level of the shoulder joint. The interscapular region is devoid of feathers. The bilateral *dorsal spinal feather tracts* begin at about the level of the first dorsal vertebra. These two dorsal tracts meet at the level of the hip joint to form a *median pelvic tract*, which terminates anterior to the oil gland.

There is a single *humeral* tract, composed of closely spaced feathers, raised above the level of the surrounding skin.

Alar tract. There are 10 primaries, 10 greater primary coverts, and 5 middle primary coverts. There are five alula quills. The carpal remex and its covert are present. The fifth secondary is present, *i.e.*, the wing is eutaxic (=quintocubital). According to the

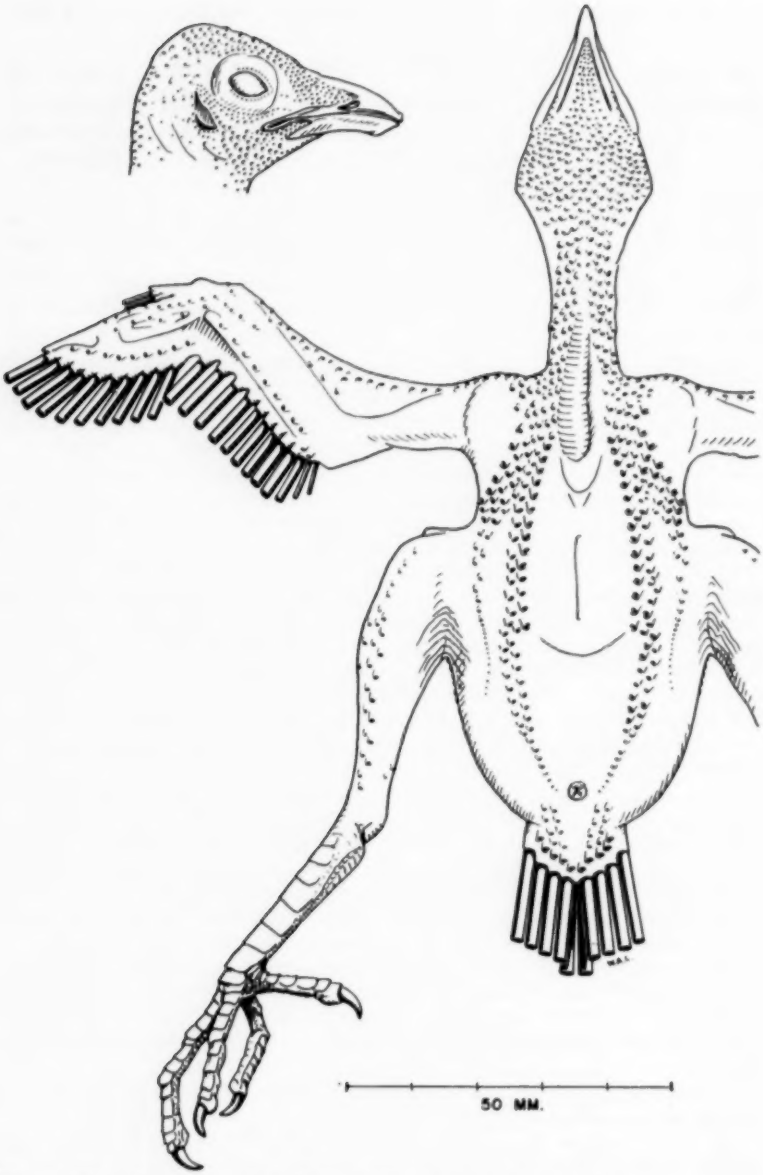

FIG. 1. Ventral view of nestling *Coua ruficeps* showing feather tracts.

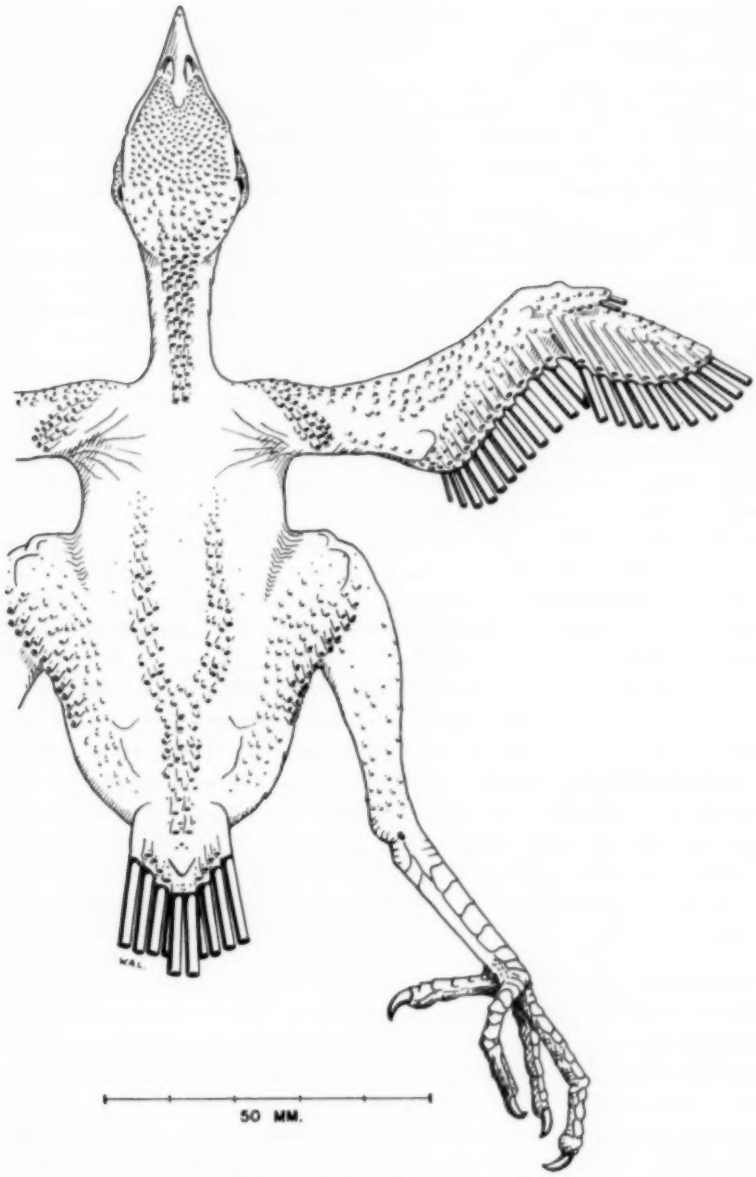

FIG. 2. Dorsal view of nestling *Coua ruficeps* showing feather tracts.

criteria we used, there are 12 secondaries, with 13 greater, 13 middle, and 15 lesser coverts. There is a distinct gap at the elbow between the secondary coverts and the tertials. (See discussion below.)

Caudal tract. There are 10 rectrices; the central pair (No. 1) is raised above the level of the others, and the second pair nearly meets beneath them. There are 8 upper and 10 lower tail coverts. The oil gland is nude. Three small feathers arising anterior to the gland send their shafts posteriorly over it.

The *femoral tract* consists of widely spaced feathers covering the outer aspect of the thigh and is bordered posteriorly by two well defined rows of very closely spaced feathers which extend onto the posteroproximal aspect of the crus.

The *crural tract* is best developed on the anterior aspect of the distal two-thirds of the crus, where it appears as a well defined, essentially double row. Laterally and posteriorly there are widely spaced feathers; the medial aspect of the crus is devoid of feathers.

Discussion

Little is known about the development of nestling plumage in cuckoos. Oberholser presented a photograph of two young *Centropus senegalensis* but made only a few general comments on the color of the plumage because many of the feathers were still sheathed and the wings and tail were "very imperfectly developed" (1899:27). Shelford (1900) described and illustrated the pterylosis of the embryo and nestling of *Centropus sinensis*. Herrick (1910: 198, 204–205) presented some data on feathers of the nestling Black-billed Cuckoo (*Coccyzus erythropthalmus*). Hartley (*in* Beebe *et al.*, 1917:309) illustrated the feather tracts in both the embryo and adult of the Smooth-billed Ani (*Crotophaga ani*).

To what extent the pattern of tracts described here for the nestling *Coua ruficeps* represents also the adult condition is not known. Nor is the feather pattern known for the nestling of any other species of this genus.

It seems probable, however, that new feathers continue to appear throughout the growth-period of the bird. Hartley's illustrations (*loc. cit.*) indicate that although the major feather tracts are visible in the embryo, additional tracts develop after hatching. In his report on the pterylosis of embryos of *Centropus sinensis*, Shelford (1900:654) spoke of the conspicuous covering of "long, white, thread-like structures" which he called "trichoptiles"; and that "dissection and microscopical examination show these threads to be enormous prolongations of the horny sheaths which envelop the developing feathers, a narrow lumen extends from the base to the tip of each, whilst the base of each lumen, again, is occupied by a feather-papilla, situated below the skin." Although Shelford found that "the arrangement of the trichoptiles is," in part, "prophetic of the adult pterylosis" (1900:666), he further stated: "The horny sheath of *all* the definitive feathers are not produced to form trichoptiles; whilst, on the other hand, certain areas occupied in the young nestling and embryo by trichoptiles are in later stages devoid of feathers" (1900:654).

In his fringillid studies, Sutton (1937) found whole new rows of feathers still coming in, particularly ventrally, after much of the juvenal plumage was complete.

There is no question that some marked change would be noted as the nestling matured. This is evidenced in the lack of symmetrical or regular alignment of feathers in the tracts, and in the great disparity in size between the "normal feathers," the much enlarged blood quills, and the minute, hairlike projections barely visible above the skin. The latter tend to be scattered, for the most part, along the periphery, and beyond the ends, of tracts. Whether they represent additional feathers that would later be as prominent as any of the others or whether they would remain rudimentary is as yet impossible to say. Some of the differences mentioned below would by inference be correlated with age, while others would represent specific characters. However, the following differences between the nestling of *ruficeps* and the adult of *caerulea* may be mentioned.

The feathers of the sterno-axillary region form a narrower and more compact tract in *ruficeps* than in *caerulea*. The inner abdominal tract extends to the anus in *caerulea*, but terminates lateral to that opening in *ruficeps*. An anal circlet of feathers is present in *caerulea;* it is lacking in *ruficeps*. In *caerulea* the outer abdominal tract turns inward to join the inner abdominal tract; in *ruficeps* the outer abdominal tract does not turn inward, and ends less than halfway between the posterior sternal margin and the anus.

In *caerulea*, the scapular region is covered by four widely separated rows of four feathers each and is connected with the spinal cervical tract by a single feather. In *ruficeps* the spinal cervical tract ends abruptly farther forward, at the level of the shoulder joint, and there is a long interscapular apterium between this tract and the two dorsal spinal tracts. In *caerulea* there is a single row of feathers down the midline in the median dorsal apterium; this character is not found in the nestling of *ruficeps*.

There is a single humeral tract in *ruficeps;* in *caerulea* there is an inner and an outer humeral tract. *Coua caerulea* has 10 secondaries; *ruficeps* 12. There is also a difference in the number of secondary coverts. In *caerulea* the secondary coverts seem to be continuous with the *distal* tertials at the elbow (see below); in *ruficeps* there is a wide diastema between the secondary coverts and the tertials.

The crowding and irregularity of feathers in the *ruficeps* nestling increase the difficulty of interpretation of certain differences between it and *caerulea*: *e.g.*, note the apparent shifting of relative positions in the region of the carpal remex and its covert. In *caerulea* the carpal remex and its covert are inserted into the dorsal surface of the basal sheath of the first primary. In *ruficeps*, however, these feathers are inserted into the skin proximal to the first primary,

i.e, in the narrow diastema between the primaries and secondaries. Degen (1894:xxvi) believed that primitively the carpal remex had its attachment on the proximal phalanx of digit III. He believed further that a shifting of feathers from the manus to the ulna resulted from the ankylosis of certain carpal and metacarpal bones, and that the mechanical disadvantage of a flight feather located at the wrist joint resulted in the reduction in size of the carpal remex. Whether or not one accepts Degen's interpretation, the intercarpal location of the carpal remex and covert in the *ruficeps* nestling probably represents only a developmental position. It seems likely that continued ontogenetic differential growth, with an increase in size of the primary quills and a decrease in relative extent of the diastema, would "pull" the carpal remex and covert onto the surface of the basal sheath of the first primary. In this event, these feathers in the adult *ruficeps* would have similar relations to those found in the adult of *caerulea*.

Certain differences pointed out above center around the elbow region. Counts of greater, middle, and lesser secondary coverts, even the counts of secondaries themselves, and the separation or non-separation of secondaries and tertials, all seem to hinge on the correct interpretation of the small and crowded feathers near the elbow. To one who has not dissected the region in detail, or to one not thoroughly familiar with the accepted criteria of the various rows and tracts, the whole set of distinctions seems somewhat subjective. It is undeniable that to the reader who gives the drawings close study, the general pattern of feathers on the elbow and lower humeral region in the two species will look closely similar (compare with illustrations in Berger, 1953).

The secondaries (=cubitals) are by definition those flight feathers which "are seated on the fore-arm" (Coues, 1903:119). Though this seems to be a simple and clear-cut definition, it is not an easy matter to determine, in all cases, where the secondaries end and the tertials begin. There has been, in fact, considerable discussion on this matter. Wray (1887:344) stated that "the term 'tertials' or 'tertiaries' has been abandoned, 'cubitals' always including them when present, because there is no way of absolutely distinguishing any definite number of remiges as belonging to this special category." Pycraft (1889:134) felt that the feathers in question should be called "inner secondaries." Degen (1894:xxi) preferred the term "parapteron," which earlier had been used by Nitzsch. Newton (1896:780) also stated that tertials "have no separate existence," but Coues (1903:119) said that the tertiaries "are properly the remiges which grow upon the arm, *humerus*. But such feathers are not very evident in most birds, and the two or three innermost secondaries, growing upon the very elbow, and commonly different from the rest in form or color, pass under the name of 'tertiaries.'" Coues further remarked

that the tertiaries "often afford good characters for description, in peculiarities of their size, shape, or color." A.A. Allen (1930:214) also said that the "innermost of the secondary group of feathers born on the 'elbow' are often elongated and spoken of as *tertiaries* or *tertials*." (For a further discussion of this problem the reader is referred to the paper by Sundevall, 1886, pp. 403–404.)

In the two specimens of *ruficeps*, all of the feathers borne on the elbow are attached either directly to the ulna or to the skin covering the olecranon process of that bone; consequently, they belong to the cubital series. It is not now possible to recheck this point on *caerulea*, but in determining the number of secondaries in that species, Berger dissected the wing so that the feathers could be traced to their bony attachments or to their position on the skin covering the ulna (the innermost secondaries are not actually attached to the bone). His statement (1953:13) that "the three rows of coverts are continuous with the tertials at the elbow," must be interpreted as meaning that in the adult *caerulea* there are small feathers located proximal to the cubital series and that they are inserted into the skin covering the distal part of the humerus and not into the skin covering the olecranon process of the ulna. The fact that the two series of feathers are in continuity increases the difficulty of deciding where one series stops and the other begins.

Probably because of this arrangement of feathers, the number of secondaries has not been used much as a diagnostic character; Ridgway (1916), for example, does not use this character. In some cuckoos, at least, the innermost two or three secondaries are progressively smaller and this fact plus the crowding of the coverts at the elbow region, makes an accurate count difficult if not impossible.

Those feathers which grow on the posterior aspect of the middle portion of the arm (=humerus) may be referred to as the tertiaries or as the parapteron. In plumage descriptions care must be taken to indicate whether a description pertains to this tract or to those sometimes elongated feathers, growing in the elbow region, which are attached to the skin overlying either the distal end of the humerus or the olecranon process of the ulna.

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ON THE SPURS ON BIRDS' WINGS

BY A. L. RAND

In handling specimens of birds bearing spurs on their wings, two points emerged which seem to be little known or new: (a) the horny covering of the wing spur, in some species, undergoes molt, and (b) the spur in some birds is a modification of a process already in existence for another purpose. In presenting these points, a summary of our knowledge regarding wing spurs is presented.

In early writings spurs and claws were confused until Jefferies (1881) pointed out that they are quite different: claws are horny sheaths on the tips of terminal phalanges (for a review of their occurrence see Fisher, 1940); spurs are projecting bony cores with an outer layer of horn, similar to the horns of cattle. Between the bone core and horn covering is a layer of tissue, the outer part of which produces new horn material. The horn must obviously increase in length from the base, the tip being the oldest (Gadow, 1891).

Well developed spurs occur on the tarsi of many gallinaceous birds, but wing spurs, all borne on the forward edge of the wing in the neighborhood of the carpal joint, are found only as follows.

Anseriformes

Anhimidae (Screamers).—All three species of this family have two conspicuous, stout, smoothly tapering, sharp spurs with a slight radial curve on each wing; the proximal spur is much the larger. They are both on the fused metacarpals; the proximal spur on the process of metacarpal I which is for the attachment of the extensor muscles; the distal spur on the distal end of metacarpal II (as figured by Sclater, 1886:150). Specimens examined show fine lines about the base of the spurs indicating growth in layers, and one specimen had three separate bands of these lines suggesting annual growth. The molt that occurs complicates this idea, however. Following are descriptions of the spurs in the three species, as seen in specimens in the Chicago Natural History Museum:

Anhima cornuta: the spur is triangular in cross section, with the side of the spur facing proximally, somewhat concave, and all the corners as well as the tip sharp; length of proximal spur, males, 58–61; females, 50–55; distal spur, males, 15, 16; females, 11–17 mm.

Chauna torquata: spur nearly oval in cross section but with a sharp-edged flange near the proximal edge, recalling the triangular, sharp-edged spur of the previous species; length of proximal spur, males, 30–47; females, 35–45; distal spur, males, 13–20; females, 15–17 mm.

Chauna chavaria (Fig. 1C): spur smoothly oval in section, sharp only at tip; length of proximal spur, male, 28; female, 30; distal spur, male, 18; female, 18 mm.

Anatidae (Ducks, Geese, etc.).—The ducks and their relatives number some 144 species. A number of genera have a projection near the carpal joint. This projection is conspicuous as a knob especially in *Sarkidiornis* and *Chloephaga* in which it projects beyond the feathering and bears a horny covering. This seems to be the process of metacarpal I. However, only two genera of the Anatidae, both monotypic, have a single well-developed spur on each wing. In the two species the spurs differ in position and some details; descriptions follow.

Plectropterus gambensis (Fig. 1D): the spur is borne on the radial carpal bone (skeleton, C.N.H.M.) as shown by Sclater (1886, p. 300). The spur is stout, strong, with a gradual taper, nearly oval in cross section, but with a tendency toward flanges giving small sharp edges. There is an area about 5 mm. from the base that suggests a growth ring in all specimens. Length of the spur in males is 20–25 mm., in females, 18–22 mm. In one specimen there is a small pad of horn on an auxiliary spur that appears to be the tip of the process of metacarpal I.

Merganetta armata (Fig. 1E): the spur is borne on the basal anterior edge of the metacarpal on the process of metacarpal I (specimen C.N.H.M.). The spurs are stout at the base, oval in section, and taper abruptly, but with an attenuated, very sharp tip. They differ from the spurs of *Plectropterus* also in that the horny sheath ends abruptly basally with an abruptly rounded edge indicating thickness of the horny covering to the base. No suggestion of growth rings is evident. Length of the spur in males is 9–17 mm.; in females, 6–13 mm. The spur of the female usually has a less attenuated and less sharp point.

CHARADRIIFORMES

Jacanidae (Jacanas).—Of the seven species in six genera in this family, only two species have well developed spurs:

Jacana spinosa (Fig. 1G) has a long conspicuous spur, borne on the process of metacarpal I (skeleton, C.N.H.M.), as figured by Sclater (1886:301). The spur is almost conical, with a slightly attenuated and very sharp tip. Faint lines suggesting growth rings are somewhat evident. The spurs of males measure 7–10; of females, 8–10 mm.

In *Hydrophasianus chirurgus* the spur is apparently similarly located and is short and very sharp; in males it measures 3–5; in females, 4–7 mm.

Another aspect of wing armature in this group is noteworthy in this connection. In *Actophilornis africana* (Fig. 1F), *A. albinucha, Metopidius indicus,* and *Irediparra gallinacea,* the radius is flattened and heavy, much heavier than the ulna (Forbes, 1881:646). In these species, spurs are absent, being represented only by the knob of the process of metacarpal I. *Jacana spinosa* and *H. chirurgus,* both with sharp spurs, have "normal" radii (Forbes, 1881:646–7).

Charadriidae, subfamily Vanellinae (Wattled Plovers and Lapwings).—Of the 25 species in 19 genera belonging to this subfamily I have examined 24[1] species in 18 genera and find a conspicuous spur in 10 species in 7 genera, a very small but distinct sharp spur in 4 species in 4 genera, and a condition in which a spur is represented only by the knob formed by the process of metacarpal I in 7 genera (see list below).

The following species have conspicuous, well developed spurs:

Species	*Length of Spur*	
	Male	*Female*
Belonopterus chilensis (Fig. 1H)	8–14 mm.	8–12
Xiphidiopterus albiceps	18–23	16–22
Rogibyx tricolor	15	no specimen
Lobibyx novae-hollandiae	16, 17	13–14
Lobibyx miles	15	no specimen
Afribyx senegallus	3–11	2–5
Hoplopterus spinosus	5–11	4–7
Hoplopterus armatus	9–12	7–12
Hoplopterus duvaucelii	11–13	6–15
Hoploxypterus cayanus	4–9	4–5

[1] I have not seen *Tylibyx melanocephalus* which is said to have no spur.

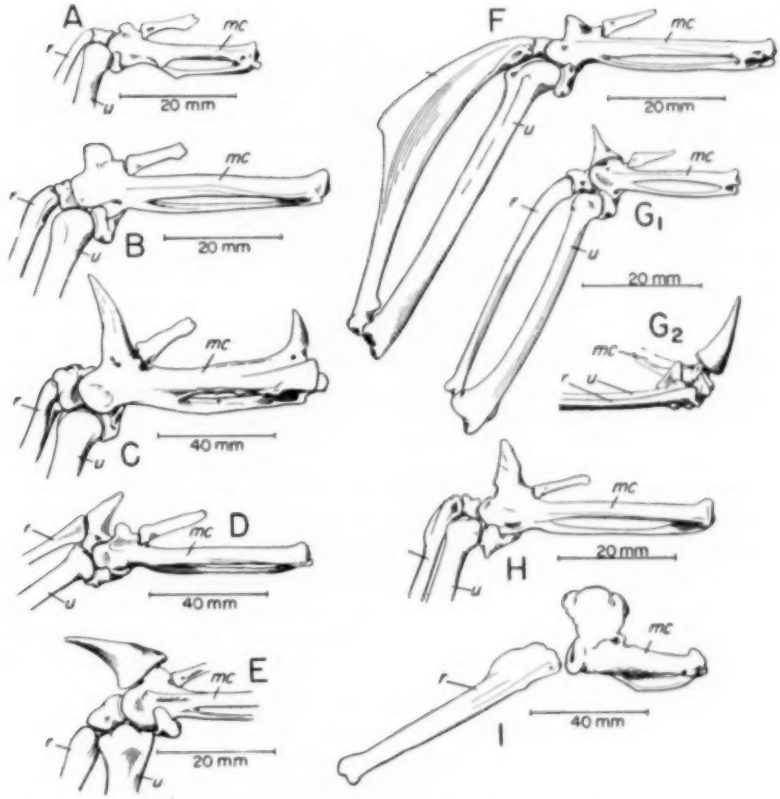

FIG. 1. Bony structures in the region of the wrist of birds. Species figured are: A, *Alectoris rufa*; B, *Haematopus ostralegus*; C, *Chauna chavaria*; D, *Plectropterus gambensis*; E, *Merganetta armata*; F, *Actophilornis africana*; G 1, *Jacana spinosa*; G 2, *Jacana spinosa*, another view, showing curve of spur; H, *Belonopterus chilensis*; I, *Pezophaps solitaria* (from Newton and Newton, 1868). A and B show "normal" process of metacarpal I; in C, E, G, and H, this process is elongated into a spur (drawn with horny sheath in E and G); C has an extra spur; D has the spur on a carpal; F has a thickened radius; I has a swollen knob on metacarpal and on radius. Abbreviations: *r*=radius; *u*=ulna; *mc*=metacarpal.

The following species, all in different genera from those listed above, have short spurs only a few millimeters long at most, but usually pointed and apparently horn covered: *Hemiparra crassirostris, Microsarcops cinereus, Lobivanellus indicus, Ptiloscelys resplendens.*

In the three species of *Stephanibyx;* the single species of *Zonifer, Lobipluvia, Sarciophorus, Anomalophrys,* and *Vanellus;* and two species of *Chettusia,* the knob formed by

the process of metacarpal I can scarcely be called a spur. *Tylibyx* is said also to lack a spur.

I have examined skeletons of but two genera of the plovers with conspicuous spurs, *Hoplopterus* and *Belonopterus*, and in these the spur is on the process of metacarpal I (Fig. 1H) as in jacanas and screamers (main spur). In the other genera the spur appears to be in a similar location and presumably is also on the process of metacarpal I.

In these plovers with well developed spur, the spurs are usually more or less oval in cross section, somewhat flattened in *Lobibyx*, rather slender, sharply pointed, and more or less distinctly curved radially. Frequently there are faint, wavy lines running around the spurs which are suggestive of growth rings (see under molt), but otherwise the spurs are smooth at the base. Usually the spurs of the female are slightly smaller than those of the male.

Columbiformes

Raphidae (Dodos, Solitaires.—No pigeons have a wing spur as such, but the wing armature of the extinct solitaire, *Pezophaps solitaria* (Fig. 1 I) of Rodriguez (Newton and Newton, 1868), should be mentioned. In this species large examples, presumably males, have a considerable enlargement of the distal end of the radius, especially at the base of the fused carpometacarpus. While apparently not sharp pointed, it may well have been horn covered and certainly could have increased the wing's effectiveness as a weapon.

Other Groups.—The older literature sometimes mentions spurs on such birds as a thrush (*Turdus*), the knob-winged pigeon (*Didunculus*) of Samoa, and the mound-builders (*Megapodius*) (Jefferies, 1881). Examination of specimens in the Chicago Natural History Museum showed no wing spurs on any of our specimens of these groups. However, the rather pronounced projection of the process of metacarpal I might be considered a rudimentary spur, as it could in most flying birds (see Fig. 1 A and B). Also, as Gadow (1891:501, 502) points out, cornification can occur sporadically on the skin of various parts of the bird's body, producing horny spurs, and to have this happen occasionally on the wings of birds which normally lack spurs is probable.

In summary, well developed wing spurs occur in: Anhimidae—2 spurs, in all 3 species; Anatidae—1 spur, in 2 of the 144 species; Jacanidae—1 spur, in 2 of the 7 species (rudimentary in all others); Charadriidae, subfamily Vanellinae—1 spur in 10 of the 25 species (present, small and sharp in a number of others).

The location of the spurs is as follows (Thomson, 1923:219), lists spurs as occurring on digits but none of his examples show this condition):

A. On radial carpal: *Plectropterus.*

B. On carpometacarpus: all others

a. on process of metacarpal I: all except the distal spur of screamers.

b. on distal end of metacarpal II near articulation of digit II: distal spur of screamers.

Functionally related structures are the enlarged radii of jacanas of the genera *Actophilornis, Metopidius* and *Irediparra* and the enlargement of the distal end of the radius and also of the proximal end of the carpometacarpus of a solitaire, *Pezophaps.*

Uses of Wing Armature

Spurs probably have their use in fighting. In many gallinaceous birds the tarsal spurs, worn only by the male, are definitely secondary sexual characters used in intraspecific fighting at mating time. Wing-spurs are well developed in both sexes of species in which they occur but those of the female are usual-

ly slightly smaller. This might imply they were not used primarily in courtship and mating. However, the jacana (*J. spinosa*) is said to have displays at mating time when with spread wings the birds act as though they were attempting to strike each other with their sharp spurs.

Some birds use their wings in fighting off enemies or intruders of other species. The swans (*Cygnus*), without spurs, make such effective use of their wings as weapons that they can be dangerous to children. The spur-winged goose (*Plectropterus*), with its formidable spurs, is said to be extremely aggressive and sometimes to injure other waterfowl with its spurs (Delacour and Mayr, 1945:28). Both male and female screamer (*Chauna torquata*) defend their nest with strong wing blows in which the spur is brought into play (Stoner, 1939:48).

One can assume that the bony enlargement of the carpal area of the solitaire and the thickened radius of certain jacanas serve to render blows more effective.

Origin of Wing Armature

Well developed wing spurs occur in only two families of each of two orders, Anseriformes and Charadriiformes. In one small family (Anhimidae) all the species have wing spurs, while in the related large family (Anatidae) about two per cent have spurs.

The diversity of the armature of birds' wings is apparent from the preceding summary. Two main effects are achieved: a club effect in two ways; a knife effect in one main and two less frequent ways.

It is interesting to note here that both club and knife or spear motive are present in one group, the jacanas, but no species has both. Those species with spurs do not have thickened radii.

Though wing armature is varied, the spur is the most common and in all but one species the spur (only the proximal spur in screamers) appears to be a continuation and modification of the process of metacarpal I, a process that in birds serves for the attachment of the extensor muscles. This process is easily felt through the skin of specimens of many, perhaps most, flying birds as a distinct point or knob. It gives the impression of a rudimentary spur. The size, shape, and position of this process apparently varies with the type of flight of the bird, as Fisher (1946:559) has demonstrated for some hawks and their relatives. Almost surely this process arose in connection with the attachment of extensor muscles. But once present, it made the wing more effective as a weapon when dealing a blow, as do some birds without spurs. Already useful as a weapon, a new set of selection factors, connected with fighting ability, could have operated to elongate the process and give it a horny coating to add to its effectiveness as a weapon. Presumably the process can maintain its first func-

tion as a point of muscle attachment and take over its new function as a weapon. This seems to be a good example of a structure arising for one purpose through the action of one set of selective factors becoming useful in quite another way when a certain point of development was reached. At this point the structure comes under the influence of another set of selective factors, and the direction of its evolution is changed. The present-day structure is the result of two sets of selective processes acting at different times.

Assuming that the process of metacarpal I is a ready made knob capable of being turned into a spur, it seems strange that this knob has been ignored, so to speak, in some species in which wing armature was achieved in other ways, as, for example, the spur on the radial carpal of the spur-winged goose (*Plectropterus*). It seems just as strange that in the jacanas certain species developed spurs while in certain other species a heavy radius was developed suitable for use as a club. No species has both.

It seems that wing armature originated separately a number of times; in the majority of cases a bony process already in existence was modified into a spur, but in some cases this process was not used and a weapon evolved along other lines.

Spur Molt

Molt of feathers usually occurs at least once a year. Molt of other epidermal structures is well known, but its occurrence is less general. Molt has been recorded for such structures as: the nails of the red grouse, *Lagopus scoticus* (Witherby, et al, 1941:227); the pectinations on each side of the toes that serve for "snowshoes" for the ruffed grouse, *Bonasa umbellus* (figured, Forbush, 1927:27); the outer sheath of the puffin's (*Fratercula arctica*) bill that serves as a nuptial adornment (Witherby, et al, 1941:172); and the "knob" on the bill of the white pelican, *Pelecanus erythrorhynchos*, that is worn during the breeding season (Baird, 1869). Apparently the spurs of domestic fowl at least do not molt, and I find only one mention of wing spur molt. Chapin (1939:86), writing of the plover *Xiphidiopterus albiceps*, says of a pair that were molting their remiges and rectrices, "Their wing-spurs were likewise about to shed the outer sheath, which could be lifted off, leaving a perfect new horny point beneath."

I have found further evidence of molt of wing spurs in three species:

(a) Screamer. *Chauna chavaria*.—In screamers there is characteristically a series of fine lines near the base of the spur which I assume are growth lines due to horn being laid down in layers. In one specimen there were three such series of lines separated by intervals. These lines I assumed to be annual growth lines. Hence it came as a surprise in handling a specimen of *C. chavaria* that an outer layer of one spur separated at the "growth ring" and slipped off as a cap, leaving the spur about 3 mm. shorter but in ap-

pearance much as it was before. This bird showed molt of flight feathers.

(b) Jacana. *Jacana spinosa.*—A specimen had long, pointed spurs (13 mm.) that showed irregular growth lines and a scaly appearance about the base. A gentle pull on each spur caused an outer layer of the horn of the spurs to slip off like a cap, leaving a pair of clean, pointed, shorter spurs (9 mm.) with less attenuated points. This specimen was also molting its remiges.

(c) Spur-winged Plover. *Hoplopterus armatus.*—A specimen had clean, fresh looking spurs 12 mm. long. A gentle tug on each spur caused the outer layer to slip off like a cap, leaving a pair of spurs similar to the old ones but about two mm. shorter. This specimen also showed molt of its remiges.

The data are scanty for generalization. The similarity of the spur before and after shedding makes it necessary to see the shed cap to realize what has happened. But from the three examples described above it appears that molt of the outer layer of the horn covering of spurs takes place in at least one species of screamer, one jacana, and two species of plovers. The correlation of this spur cover molt with wing molt indicates the former may be a regular part of the annual molt.

The structure of the spurs of birds has been compared to that of horns of cattle by Gadow. It is interesting to compare the molt of the covering of the spurs on wings of birds with the annual molt of the covering of the bony core of the horns of the Pronghorn, *Antilocapra,* which is similar.

Summary

The occurrence of wing spurs is noted for all species of screamers, some plovers, two jacanas, and two ducks. Additionally, knob or club-like wing armature is listed for several jacanas and a pigeon. These specialized structures occur on different parts of the wing and involve the radius, the radial carpal, or the fused metacarpals depending on the species. The structures are apparently used in fighting.

The process of metacarpal I (for the attachment of the extensor muscles) has been modified into the spur in a great majority of cases. This process presumably arose in connection with the insertion of muscles, and its size and location are influenced by the type of flight. But another result was that this knob made the wing more effective as a striking organ. This knob was then acted on by a new set of selective factors, those involved in providing the bird with better weapons, and a spur was produced. However, in a few cases wing armature developed independently from other parts of the wing.

Molt of an outer cap-like layer of the horny covering of the spur in a single piece is recorded in four species. In each case this molt was correlated with wing molt. It is possible that the annual molt may regularly include the outer covering of the spur.

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Chicago Natural History Museum, Roosevelt Road and Lake Shore Drive, Chicago 5, Illinois, March 26, 1953

GENERAL NOTES

Predation on bats by hawks and owls.—In the course of a year's investigation of the cave bats of the gypsum caves of south-central Kansas and northwestern Oklahoma, I made several observations on bat predation by hawks and owls which may be of interest.

On October 2, 1952, I saw a Barn Owl (*Tyto alba*) preying on Mexican free-tailed bats (*Tadarida mexicana*) while the evening flight of the latter was emerging from the entrance of Merrihew Cave (¾ mile south and ⅛ mile west of the Barber and Comanche, Kansas, county lines in Woods County, Oklahoma). The Mexican free-tails, which occur in this cave in great numbers from April until the middle of October, begin their evening flight shortly after sunset at this time of year. When flying from the cave interior to the outside, they form a steady stream consisting of numerous bats per cubic yard. It seems that they do not utilize echo-location while flying in such a dense flock. At 7:00 p.m., when visibility was still fairly good, a Barn Owl soared into this stream of bats at a height of about 20 feet above the ground and approximately the height of the top of the cave entrance. The bats made no apparent effort to dodge the owl. Approximately 10 feet in front of the cave entrance, the owl threw its head up and feet down and went into a kind of a stall. It was my impression that several bats hit the owl on its wings and breast and that one was picked off the breast with one foot. The owl then wheeled sharply and flew to a knob on the prairie some 75 feet away to devour its prey. Several minutes later the process was repeated. A third soaring attack into the flying stream of bats was unsuccessful and the owl immediately flew into the stream a fourth time, this time catching a bat and carrying it to an elm tree on top of the cave entrance. The owl seemed to use the same technique on each subsequent attack as described for the first. Macy and Macy (1939. *Jour. Mamm.*, 20:252) record two Red-tailed Hawks (*Buteo jamaicensis*) feeding on Free-tails at this same cave in August, 1934.

On the afternoon of December 7, 1952, while making homing experiments, I released 20 cave myotis (*Myotis velifer incautus*) at a wheat field on the state line ¼ mile east of the Comanche County line in Barber County, Kansas. The bats upon being released made two or three wide circles several hundred yards in diameter and then flew off ¼ to ½ mile and alit on trees or farm buildings. The following events were watched with binoculars. The fifth bat released circled once, then flew south, east and then north at a height of about 50 feet. At this time, a buteonine hawk soared from the north slightly above the bat, turned and struck at the bat from behind with its feet. The bat, however, darted about and began to climb. Although I did not collect this hawk, I tentatively identified it as a Rough-legged Hawk (*Buteo lagopus*) as a large white patch at the base of the tail was conspicuous. The hawk again attacked, the bat dipping to the side at the last moment. The bat continued to climb and the hawk missed twice more. At this point, a Sparrow Hawk (*Falco sparverius*) flew in from the north; this bird made two quick attacks upon the bat, both unsuccessful. The fifth attack by the buteo failed but on the sixth it appeared to throw itself downward, striking the bat with the right wing. The hawk immediately seized the bat with the left foot and flew back in the direction from which it came. The Sparrow Hawk also flew off to the north to a tree approximately ½ mile away.

I released another myotis and within less than a minute the Sparrow Hawk attacked it making four quick strikes the last of which was successful. The bird again flew off to the north. After a few minutes, another bat was released. The Sparrow Hawk again flew quickly after the bat, knocked it to the ground, and dived and captured it.

On February 27, 1953, at 5:00 p.m. while I was releasing bats 200 yards north of the mouth of Merrihew Cave, a Sparrow Hawk dived at a cave myotis as it flew into the cave entrance. The falcon missed and turned sharply aside, not following the bat into the cave. Several minutes later after the falcon had returned to its perch on a cedar tree approximately 100 yards southeast of the cave entrance, I released a second myotis. This time the falcon flew quickly towards the bat and dived at it from five feet above and missed it; the bird immediately flew over the bat again and neatly picked it out of the air with its claws. The Sparrow Hawk then carried its prey to the same cedar tree and there ate it.

On July 17, 1953, at Lost Colony Cave (4 miles south and 3½ miles west of Aetna, Barber County, Kansas) as I was observing the morning flight of cave myotis into the cave I saw a Sparrow Hawk dive on one of the many bats milling above the cave and catch it on the first attempt. This occurred at 4:58 a.m. when the illumination from the sky was less than one foot-candle. At 5:12 a.m. (illumination 13 foot-candles), an unidentified buteonine hawk was seen to make a sally at one of the many myotis returning from the east at this time, but I could not see whether or not a bat had been captured.

In addition to the above observations, I collected owl pellets from wood rat (*Neotoma*) houses near the entrances of caves. Three pellets, tentatively identified by size and shape as of Barn Owl origin, from Merrihew Cave contained remains of four, three, and two Mexican free-tailed bats each; three others contained one bat each of this species. A pellet identified as that of the Great Horned Owl (*Bubo virginianus*) contained six Mexican free-tails. All of these pellets contained only bats.

I have frightened Barn Owls from May's Cave (4 miles south and ½ mile west of Aetna, Barber County, Kansas) at all seasons of the year. This cave is occasionally occupied by the cave myotis and the Bunker bat (*Antrozous bunkeri*). A Barn Owl pellet from this cave yielded the remains of a Bunker bat and parts of a cottontail rabbit (*Sylvilagus*). I found a pile of bones 54 feet within this cave in a shallow concavity of a rock three feet above the cave floor. From the good condition of skulls and jaws, I judged these bones to be remains from owl pellets. Included in these bones were an amphibian jaw, a jaw of the collared lizard (*Crotaphytus collaris*), and remains of many small mammals including 10 cave myotis, three Mexican free-tails, and one Bunker bat.

With the exception of the pellet from May's cave, the identity of the pellets was tentatively determined by either Thane S. Robinson or Harrison B. Tordoff of the University of Kansas Museum of Natural History.—John W. Twente, Jr., *Department of Zoology, University of Michigan, Ann Arbor, February 13, 1954.*

A wintering concentration of eagles in Oklahoma.—A concentration of 108 eagles was counted on the Salt Plains National Wildlife Refuge near Jet, Oklahoma, on December 26, 1953. More were undoubtedly present in areas of the refuge not censused. It is known that the majority of the adult birds were Bald Eagles (*Haliaeetus leucocephalus*), and adult Golden Eagles (*Aquila chrysaetos*) also were observed. We made no attempt to identify immatures to species; however, on the basis of identifiable adults it is probable that more than 75% of the population were Bald Eagles.

It is common for eagles to winter on the refuge in numbers around 100. In 1953, one Golden Eagle remained for the summer, while two immature Golden Eagles arrived on October 5. On December 10, there was a mass immigration of 50 individuals including both species. Normally, the population decreases in March, and by the latter part of April all eagles have departed.—John B. Van den Akker, *Salt Plains National Wildlife Refuge, Jet, Oklahoma, January 1, 1954.*

Mourning Doves nest in Black-crowned Night Heron nests.— On June 14, 1952, during banding operations in a large colony of Black-crowned Night Herons (*Nycticorax nycticorax*) on Harsen's Island, St. Clair County, Michigan, I found two young Mourning Doves (*Zenaidura macroura*) about eight days old in an unoccupied nest of this heron. The colony was in a permanent marsh where the water was 40 inches deep at the time. The heron nest was only 25 inches above the water in a small willow (*Salix* sp.). The doves had added only a few scattered straws to the original nest which was composed largely of coarse willow twigs, the entire mass being 20 inches in diameter. The Mourning Dove young were in the center which was slightly depressed. They were being brooded by an adult which left the nest reluctantly. Several occupied nests of the heron were nearby. Mention was made of this nest in "Bird Survey of the Detroit Region," 1952, Detroit Audubon Society.

On July 12, 1953, in the same colony, I found a Mourning Dove sitting on two eggs in a heron's nest in the same part of the colony. This was a nest which I had tagged and numbered 17 on June 7. At this time it held two eggs and one newly hatched young of the heron. The nest was 90 inches above the water in the upright fork of a willow. No new material appeared to have been added by the Mourning Doves.—WALTER P. NICKELL, *Cranbrook Institute of Science, Bloomfield Hills, Michigan, December 14, 1952.*

Yellow-billed Cuckoo's egg in Mourning Dove's nest.—On June 10, 1952, I found one egg of the Yellow-billed Cuckoo (*Coccyzus americanus*) in the nest of a Mourning Dove (*Zenaidura macroura*). The location of this nest was on the Cranbrook Estate in Bloomfield Township, Bloomfield Hills, Michigan. The measurements of the egg were 33.6 mm. by 23.3 mm. This nest, built on a horizontal branch at its juncture with the axis 92 inches above the ground, was discovered on April 29. It held two small nestlings of the Mourning Dove on this date. The young doves were banded on May 5, and observed on May 6, 11, and 13. They flew on the latter day. The empty nest, being beside the path which I walked three times daily to and from the Cranbook Institute of Science, was observed many times between May 13 and June 10 when the cuckoo egg was deposited. A Yellow-billed Cuckoo was heard in the vicinity several times previous to the deposition of the egg. I left the egg and made daily observations through June 16 but saw no cuckoo at the nest; on June 16 the nest and its contents were collected.—WALTER P. NICKELL, *Cranbrook Institute of Science, Bloomfield Hills, Michigan, January 4, 1954.*

Red-wings hatch and raise a Yellow-billed Cuckoo.—On June 2, 1953, when revisiting a nest of the Red-wing (*Agelaius phoeniceus*), I found that it contained three eggs of the hosts and one of the Yellow-billed Cuckoo (*Coccyzus americanus*). A fourth Red-wing egg lay broken on the ground directly below the nest. The nest was in a shallow marsh in southeastern Pontiac Township, Oakland County, Michigan. I had found this nest May 17 when it was not yet lined. Its height above the wet ground was seven feet, and it was fastened to five upright branches in the forks of a shrub willow (*Salix* sp.). A durable tag, numbered 10 for this location, was tied to the nest shrub on May 17. When visiting the nest again on June 11, I found two Red-wing nestlings about six days old and a Cuckoo nestling about the same age. The cuckoo exhibited wing quivering and a buzzing noise in a characteristic fashion. All three young were banded. I watched the nest for about half an hour from a distance of 30 feet with 7 × 35 binoculars. During this time the male Red-wing fed the young once and the female fed twice;

I could not see how the cuckoo was fed as the nest was too high. On June 14, three days later, the Red-wing nestlings crouched in the bottom of the nest when I lowered it for observation. The cuckoo stood erect with beak pointed upward for a moment, then climbed over the side of the nest. Its feathers had already burst from their quills and it appeared to be ready to leave the nest. The bottom of the nest was filthy from the cuckoo droppings which had not been removed by the Red-wings. My observations of many nestling cuckoos, both Yellow-billed and Black-billed (*Coccyzus erythropthalmus*) indicate that the droppings are not encased in gelatinous envelopes. The cuckoo was replaced in the nest where it remained until I left several minutes later. On June 18 the nest was empty, and I was unable to locate the young in the vicinity. According to many observations I have made on both nestling Red-wings and Yellow-billed Cuckoos, the cuckoo would have left the nest, normally, on the 9th or 10th day after hatching which would have been June 15, the next day after my last observation of the nestling. The nestling Red-wings normally should have left a day or two later or at least a day before I found the nest empty. I did not see adult cuckoos in the vicinity at any visit to the nest, but heard one calling at a distance on May 17, the day the unfinished nest was found.

While eggs of the Yellow-billed Cuckoo have been found in nests of the Robin (*Turdus migratorius*), Catbird (*Dumetella carolinensis*), Dickcissel (*Spiza americana*), Black-throated Sparrow (*Amphispiza bilineata*), Wood Thrush (*Hylocichla mustelina*), Cedar Waxwing (*Bombycilla cedrorum*), and Cardinal (*Richmondena cardinalis*), reported from several observers by A. C. Bent (1940. *U. S. Natl. Mus. Bull.* 176:56), I have not found any record of the eggs of this species in the nest of the Red-wing. The cuckoo egg was not measured, but was distinguished by its larger size, more oval shape, and lighter color from that of its black-billed relative.—WALTER P. NICKELL, *Cranbrook Institute of Science, Bloomfield Hills, Michigan, January 4, 1954.*

Avocets nesting in Kansas.—On May 15, 1951, two nests of the Avocet (*Recurvirostra americana*) were located by the writer in Finney County, Kansas, seven miles north of Garden City. One nest contained four eggs and the other, three eggs. The nests were again visited and photographed on May 22, 1951. The nest that previously contained three eggs had been destroyed. A third nest, containing four eggs, was located and of these two remaining nests, one was destroyed by the destructive hail storm of May 30, 1951. Eggs in the other nest hatched and the young survived.

During the spring of 1952 the writer located two more Avocet nests about four miles west of the nests observed the previous year. One of the two nests was destroyed by some unknown predator; three of the four eggs in the other hatched and the young survived. The pond around which the nests were observed in 1951 was dry in 1952 because of drought in the area.

On June 26, 1953, the area that had breeding birds in 1952 was again visited. Seven nests were located; all were on islands within the lake and each contained the full clutch of four eggs.

There are few previous nesting records of the Avocet in Kansas. Mr. Ed Gebhard of Meade, Kansas, told me that he has seen nests in wheat fields and around potholes in Meade County. Also, Mr. Frank Robl of Ellinwood, Kansas, told me he has seen nests in the Cheyenne Bottoms area of Barton County. It appears that the Avocet is a rather rare, but widely scattered nesting bird in western Kansas.—MARVIN D. SCHWILLING, *Forestry, Fish, and Game Commission, Box 864, Garden City, Kansas, August 1, 1953.*

Olathe Quail in Utah.—The Olathe Quail (*Lophortyx gambelii sana* Mearns), a pale washed-out subspecies of Gambel's Quail, has been considered to be confined to western Colorado in the drainage areas of the Uncompahgre and Gunnison rivers and the portion of the Rio Grande Valley lying in Colorado. During the summer of 1953, a Peabody Museum Expedition made a natural history survey in portions of Nebraska, Colorado and Utah. Two specimens of Gambel's Quail were collected, which, on comparison with three specimens of *sana* kindly loaned to me by the United States National Museum, prove to belong to that subspecies. A female with ovaries "granular" was collected August 17 two miles southwest of Fruita on the south bank of the Colorado River some fifteen miles east of the Colorado-Utah line. A male in breeding condition was collected July 22 near the McElmo River south of the Hovenweep National Monument in southeastern Utah, an extension of range into Utah for this form.

Both birds were collected in barren grassland on the edge of badlands, on higher ground above the river bottoms.—S. Dillon Ripley, *Peabody Museum of Natural History, Yale University, New Haven, Connecticut, November 25, 1953.*

North American birds on the Brazilian coast.—While visiting the Cabo Frio region (State of Rio de Janeiro) of Brazil from March 16 to 19 and August 3 to 5, 1953, I made some observations on wintering or migrating species of Northern Hemisphere birds. Although I collected no specimens, the records here presented may be of some interest, particularly in the case of the Arctic-nesting shore birds.

Cabo Frio is about 100 kilometers east of the city of Rio de Janeiro at approximately 23° S. latitude. The Cape is a bold headland which projects eastward into the Atlantic and in the vicinity are many long curved beaches, characteristic of this coast line, while behind the beaches are brackish and salt lakes and ponds, some tidal, some not. There are also many salt beds in the region where salt is obtained by the evaporation process.

Along the shore, or on these various lakes and ponds with their accompanying mud flats, the following species were seen:

Osprey (*Pandion haliaetus*).—An Osprey was observed on March 16 in the immediate vicinity of the Cape, where I saw it catch a fish in the open ocean and fly with it some distance across a bay where the bird disappeared behind a rocky headland. The Osprey reappeared quickly without the fish. The same bird, or another, was observed the next day in the vicinity circling at a great height with Frigate Birds (*Fregata magnificens*) and gulls. I saw an Osprey on a beach near the city of Rio de Janeiro on May 28, 1952, which is a very late date for a migrant.

Semipalmated Plover (*Charadrius hiaticula*).—Several of these plovers were with other shore birds on two different tidal mud flats and on the grassy shore of one of the large lagoons in March. Probably a total of a dozen were seen.

Ruddy Turnstone (*Arenaria interpres*).—Two seen August 3, on salt pans, in winter plumage. According to Pinto ("Catalogo das Aves do Brasil," 1938) this region is about the southern limit for wintering turnstones.

Spotted Sandpiper (*Actitis macularia*).—Two were with a mixed group of shorebirds on a tidal flat in March. One was in summer plumage and one in winter plumage.

Greater Yellow-legs (*Tringa melanoleuca*).—Five birds, apparently of this species, were seen on August 3 on salt pans near Araruama. Three were seen on August 4 on a mudflat of a small river also near Araruama. (Junea W. Kelly, of California, saw three Greater Yellow-legs on the salt pans June 1–3, 1953, so that evidently some of the birds are non-breeders and loaf away the northern summer here. She did not see any other species of shore-birds at that time.)

Lesser Yellow-legs (*Totanus flavipes*).—One was seen in March feeding on the edge of a drained salt bed.

Sanderling (*Crocethia alba*).—Flocks of 15 to 20 Sanderlings were seen in March on both mud flats and open beaches; those on the open beaches were very restless, frequently flying long distances along the shore. Nearly all were still in pale winter plumage. Six were seen with the Yellow-legs and Turnstones on August 3. These were also in winter plumage.

Barn Swallow (*Hirundo rustica*).—This species was the only one seen in March that could be definitely said to be migrating. Throughout the morning of March 17, flocks were passing northeastward, cutting across the sandy scrubby growth area to landward of the Cape.

One wonders to what extent these various migrants follow the shoreline. If they do so around the great eastward "bulge" of Brazil it would lengthen their journey enormously. In this connection, and showing that such is not always the case, it is perhaps of interest to record that I saw a Ruddy Turnstone (*Arenaria interpres*) at sea, flying directly south, on November 18, 1952, at a point roughly 100 miles from the Brazilian coast at about 10° S. latitude, or a short distance south of the easterly tip of the "bulge."—Margaret H. (Mrs. Osborne) Mitchell, *Caixa Postal 4965, Rio de Janeiro, Brazil, April 24, 1953.*

Observations of sea birds off the southeastern Florida coast.—From September, 1952 to June, 1953 I was on eight voyages of the University of Miami Marine Laboratory's research vessel, T-19. Most of these one or two day trips were for the purpose of collecting plankton in the Gulf Stream between Miami and the Bahama Islands. Since little is known of the fall, winter, and spring distributions of many sea birds, careful observations and notes were made during the voyages. The results are given below by dates.

October 11: During about four hours of observation approximately 6 miles east of Miami, no sea birds of note were seen.

October 16–17: During this two day trip the T-19 maintained a position approximately 10 to 15 miles off the coast, drifting as far north as Ft. Lauderdale by the end of the second day. About eighty per cent of the daylight hours was spent on watch. On October 16 no sea birds of note were seen, but a Burrowing Owl (*Speotyto cunicularia*) circled the ship several times during the early morning. On the second day, in the late afternoon, an adult Pomarine Jaeger (*Stercorarius pomarinus*) in light plumage flew over the ship. Shortly after this a Cory's Shearwater (*Puffinus diomedea*) or a Greater Shearwater (*P. gravis*) flew across the bow. The light underparts were easily seen, but positive identification could not be made since there is a considerable amount of color variation in these two species. For several hours of the day a Clay-colored Sparrow (*Spizella pallida*) remained aboard, apparently exhausted. This seems to be an unusual record of a species that normally winters in Mexico.

November 25: The trip on this day lasted about five hours, about 10 miles east of Miami. The seas were moderate to heavy, and the wind was about 20 m.p.h. from the east. Twelve Sooty Shearwaters (*Puffinus griseus*) and eighteen Audubon's Shearwaters (*P. lherminieri*) were counted. An adult Gannet (*Morus bassanus*) was seen at a fairly close range. Again one Pomarine Jaeger was seen at very close range. It was an immature bird and in dark plumage. I am convinced that the identification was correct, because of the large size of the bird and the robust appearance of body and bill.

December 4: The entire daylight period was spent from 10 to 25 miles east of Miami in moderate to heavy seas with a 20 m.p.h. wind. About nine hours were spent on watch. Altogether, twelve jaegers were seen. Five of these were definitely Pomarine

Jaegers. Of these, two were adult birds in light plumage, and one was an adult in dark plumage. The two immature birds were seen in company with one of the adults. One adult Long-tailed Jaeger (*Stercorarius longicaudus*) was seen near dusk. The tail was very long; the bird was in light plumage and was certainly this species. Six other jaegers were seen, but could not be identified. I also saw two Sooty Shearwaters.

December 9: Again the entire daylight period was spent about 25 miles east of Miami. The seas were heavy and the wind strong. Three jaegers were seen, two of which appeared to be Long-tailed Jaegers, but identification was not certain.

January 8: The morning daylight hours were spent about 6 miles east of Miami. The seas were heavy. No sea birds were observed.

March 25: About eight hours of daylight were spent on watch 10 miles east of Miami. The seas were moderate to heavy. I saw only a single American Coot (*Fulica americana*) on the water about 5 miles from shore.

April 23–24: Most of the first day was spent en route to a position approximately 35 to 40 miles east of Miami within sight of Bimini, Cat Cay, and Gun Cay of the Bahama Islands. This position was maintained through the daylight of the second day. The seas and wind were moderate to slight. About seventy per cent of the daylight was spent on watch. During the first day only one doubtful Parasitic Jaeger (*Stercorarius parasiticus*) turned up. The second day produced six jaegers and two Audubon's Shearwaters. One of the jaegers was dark and large and probably was a Pomarine Jaeger. Five however, were definitely Parasitic Jaegers. Two were adult birds with variations of the light plumage, and three were immatures, seen with the adults. Many Sooty Terns (*Sterna fuscata*) and at least six Bridled Terns (*S. anaethetus*) were observed. In midday a Chuck-will's-widow (*Caprimulgus carolinensis*) circled the ship for fifteen minutes, attempting to land several times. I saw it at very close range, and the size and lack of white identified it as this species.—Richard W. Castenholz, *Department of Botany, The State College of Washington, Pullman, November 16, 1953.*

King Eider in West Virginia.—On November 28, 1953, along the Ohio River about 15 miles northeast of Huntington, Cabell County, West Virginia, two boys shot an unknown duck. They brought the bird to me that night, when I identified it as a King Eider (*Somateria spectabilis*). The presence of testes along with its plumage characteristics showed it to be an immature male. George Sutton has since verified the identification, and Maurice Brooks has informed me that it is the first record of the species for West Virginia.

The general color of the bird is dark brown above and lighter brown below. Many of the contour feathers have buffy tips which give the bird an overall mottled appearance. There is no indication of adult male plumage, and the large square frontal processes of the adult male are lacking. The feathers on the forehead extend to the hinder edge of the nostrils which is characteristic of this species.

It is interesting to note the occurrence of this species in neighboring states. For Ohio, Brooks (1940. *Auk*, 57:563–564) lists four records; for western Pennsylvania, there are seven records (Todd, 1941. "Birds of Western Pennsylvania."); for Virginia, five (Murray, 1952. "A Check-list of Virginia Birds."), all in the coastal region. There are no records of the species for Kentucky. There are occasional winter records on the coast for North Carolina, South Carolina, and Georgia. This West Virginia specimen then appears to be the most southern inland record of the species for eastern United States.

The testes were 3 mm. × 9 mm. The bird was not fat. The specimen, No. 44A–1, is in the Marshall College collection.—Ralph M. Edeburn, *Marshall College, Huntington, West Virginia, February 16, 1954.*

An American Bittern with a deformed bill.—On August 6, 1953, James B. Fleugel brought to me an American Bittern *(Botaurus lentiginosus)* which had been found standing on the shoulder of a road through a marshy area in Kalamazoo County, Michigan. The bird's lower mandible was slightly twisted and somewhat recurved. Its upper mandible was sharply decurved, crossing the lower on its left side. The weight of the living bird was only 256 grams.

Several teaspoonfuls of ground horse meat plus strips of freshly caught fish were force-fed to the bird between August 6 and August 10, 1953, the date when it died. At first the food was promptly expelled from the esophagus, but later it was accepted more readily. In spite of this feeding, the loss of weight continued; the bird weighed 235.5 grams at death.

The bittern was taken to the University of Michigan Museum of Zoology where P. S. Humphrey made the following additional observations. The bird was a juvenal female and contained no fat. The oviduct was visible and about 1 mm. wide, and the ovary was 12 × 3 mm. The breast muscles were much reduced; the gall bladder was probably much enlarged (14 × 11 mm.) and very dark blue-green.

Since the bill of this bird obviously had grown into this aberrant shape over a period of at least several weeks (*i.e.*, it was not suddenly and recently wrenched into that shape), it would be interesting to know how this bird was able to live as long as it did.—H. Lewis Batts, Jr., *Biology Department, Kalamazoo College, Kalamazoo, Michigan.*

Peculiar wall-scaling tactics in the English Sparrow.—During the early autumn of 1953 an estimated 400 English Sparrows (*Passer domesticus*) established a roost on an ivy-covered wall at Bradley University, Peoria, Illinois. By October defoliation of the ivy had progressed to the extent that a number of the roosting birds became completely exposed. On October 7, I observed an interesting tactic employed in ascending the vertical walls of the building. An excerpt from my field notes follows: "5:14 p.m.—A female, located about 15 inches below a male, crawled laboriously up the wall to within 5 inches of the male. During this ascent the female braced herself on two different occasions with her widely spread tail and wings. At this point in the ascent the male threatened the female and caused her to withdraw to her original perch. A few moments later the female again began her laborious ascent until she attained a position about 8 inches below the male. At this point she suddenly lost her footing and slipped downward a few inches to a slender twig where she clung crazily for five seconds while in an inverted position."

During these ascents the female at times utilized the slender vine branches for anchorage purposes. On several occasions, however, it was apparent that no leverage was attained other than that provided by the contact of her clutching toes, stiffened and widely disposed rectrices, and the tips of her out-stretched primaries against the weathered brick wall.—Oliver S. Owen, *Bradley University, Peoria, Illinois, November 13, 1953.*

Aerial feeding by the English Sparrow.—On September 27, 1953, at 4:45 p.m., I was on the roof of Bradley Hall on the campus of Bradley University, Peoria, Illinois, inspecting the English Sparrow (*Passer domesticus*) roost in the ivy covering the south and west walls. At this time at least six sparrows were observed feeding on flying insects, considerable numbers of which were in evidence several feet directly above the roof. One female sparrow perched quietly on top of the west wall, peered upward at the insects for ten seconds, then suddenly sallied upward at a 75 degree angle to a height of at least ten feet, seized an insect in its bill, and returned to the roof. This individual repeated the feeding maneuver to heights of three and four feet. The entire performance was very reminiscent of the feeding habits of flycatchers. One sparrow, flying leisurely over the roof, suddenly sallied upward six feet from its line of flight, apparently secured an insect, and then continued in its original direction.—Oliver S. Owen, *Department of Biology, Bradley University, Peoria, Illinois, November 1, 1953.*

Aerial feeding by White-crowned Sparrows.—On Oct. 24, 1953, at the Impounding Reservoir near Des Moines, Iowa, I was watching a group of immature White-crowned Sparrows (*Zonotrichia leucophrys*) in several young elm trees which were overgrown by a wild grape vine. Because of the mild weather, the grapes had not become withered and dried and the birds were eating these. Suddenly I noticed that several of the sparrows in the top of the tangle of vine were occasionally springing 15 or 18 inches in the air, returning to their former positions. Upon looking more closely with my binoculars I saw a swarm of gnats or other small insects hovering over the vine; the birds were catching, or attempting to catch, these. This was a feeding procedure which I had not seen before and which I do not find described in the literature.—Woodward H. Brown, *4815 Ingersoll Avenue, Des Moines, Iowa, October 28, 1953.*

A hybrid between the Chipping and Clay-colored sparrows.—Hybrids between species of emberizine finches are rare; aside from crosses within the genus *Junco*, Cockrum (1952. *Wilson Bull.*, 64:150) lists but three such hybrids from North America. Of the three, one involves the genus *Spizella*, a record by Suchetet (1897. "Des hybrides à l'état Sauvage." I. Paris, J. B. Baillière et Fils) of a hybrid between the Clay-colored and Brewer sparrows (*Spizella pallida* and *S. breweri*). I have been unable to find this book, and it is possible that the "hybrid" was a specimen of *Spizella breweri taverneri*, which was described subsequent to Suchetet's work.

The scarcity of hybrids between species of the genus *Spizella* is perhaps surprising because two or more species of the genus nest in similar or adjacent habitats over wide areas. Chipping and Field sparrows (*Spizella passerina* and *S. pusilla*) are found nesting in the same field-borders and hedgerows throughout much of the northeastern United States; and in parts of Michigan, Wisconsin, and Minnesota, the Clay-colored Sparrow may be found in the same areas as the Chipping and Field sparrows.

Lovells, Crawford County, Michigan, is in the region where the three spizellas are all found as breeding birds. Here, Almerin D. Tinker collected two sparrows on May 29, 1932. One, a Clay-colored (number 510 in Tinker's field catalogue), was skinned by Norman A. Wood, and the other, number 511, by Tinker, himself. The latter skin appears to be a hybrid between the Chipping and Clay-colored sparrows. (It is interesting to speculate on what might have happened if Wood had prepared the hybrid and Tinker, the other bird; under those circumstances, I doubt that the hybrid would have remained undetected for 21 years. It is also interesting to note that when the hybrid was catalogued as number 115,640 in the collection of the University of Michigan Museum of Zoology, it was listed as a Chipping Sparrow.)

The most striking thing about the specimen is the color of the crown. The anterior part is dark with a light median stripe. The central (and largest) part is rufous with dark shaft streaks, which are broad on the feathers near the side of the crown and narrow on the feathers of the central part and thus form indistinct dark lateral and light median crown stripes. The effect of the light median crown stripe is heightened by some pale markings on the central feathers of the crown. The posterior part of the crown is lighter than the central part, is between rufous and grayish buff, and is streaked with dusky like that of a first-year Chipping Sparrow; unlike that part of the Clay-colored, there is no pale central stripe.

The bird also shows its hybrid origin in the color of its bill: the maxilla is dark except laterally at the base, and the mandible is light except at the tip. (At this season, the bills of Chipping Sparrows are all black, and those of the Clay-colored Sparrows are light except at the tip.)

In the length of the wing and in tail/wing ratio, the hybrid is also intermediate between the two supposed parent species.

	Wing length	*Tail length*	*Tail/wing*
Chipping Sparrow[1]	70.3 mm.	59.1 mm.	0.845
Hybrid	66.8	61.9	0.925
Clay-colored Sparrow[1]	61.4	60.2	0.982

[1]Mean of eleven males from the Lower Peninsula of Michigan.

(There is little difference between the lengths of the tails of birds of the two parent species; that of the hybrid is near the maximum size for both of these species.)

In other characters, the hybrid nature of Tinker's specimen is less striking. The ground color of the back is intermediate between the average color of that part in the parental species but can be matched by individuals of both. The dark streaks on the back are like those of most Chipping Sparrows but can be matched by those of some Clay-coloreds. The sides of the face and the ear coverts are light grayish buff, like the same areas of a Clay-colored but paler. The superciliary stripe is whiter than that of the Clay-colored and more like that of a Chipping Sparrow. The dark transocular stripe resembles that of a Clay-colored in being brownish black and in not extending anterior to the eye. There is a light "moustache" stripe like that of a Clay-colored but grayer than in most individuals of that species.

Tinker's catalogue gives little information about the specimen except that it was a male with "testes only slightly developed." This comment cannot be taken as an indication of possible sterility because the same comment was made about the Clay-colored Sparrow taken on the same day.—Robert W. Storer, *University of Michigan Museum of Zoology, Ann Arbor, Michigan, February 26, 1954.*

A fossil thrasher from the Pleistocene of Mexico.—Through the kindness of Dr. Claude W. Hibbard, I have been able to examine the tarsometatarsus of a thrasher from the Valley of Tequixquiac, Mexico. The exact site from which it was taken was Locality 8 (Hibbard, *Univ. Nac. Autonoma Mex., Inst. Geol. Boletin*, in press) just below Puente de Gallo, along the north bank of the Barranca de Acatlan, in deposits of Becerra Superior (Late Pleistocene). The specimen, number 49-26A in the collection of the Instituto Geologia Mexicana is tentatively referred to *Toxostoma ocellatum* (Sclater).

In its configuration, the bone closely resembles the corresponding element of *Toxostoma curvirostre*, but it is larger (36.7 mm. in total length) than three tarsometatarsi of that species in the skeleton collection of the University of Michigan Museum of Zoology (34.1, 34.2, and 35.5 mm.). Engels (1940. *Univ. Calif. Publ. Zool.*, 42:373) gives 32.7 $\pm$ 0.15 mm. for the mean and standard error for the length of the tarsometatarsus of

this species but states (*op. cit.*:366–367) that the measurements of limb elements were "taken between proximal and distal articulating surfaces in such a way that their sums would most closely approximate total limb lengths." An attempt to approximate Engels' method of measurement yields figures approximately 1 mm. shorter than the total length, or 35.8 mm. for the fossil. The standard deviation (σ) of Engels' sample of this species is 0.90, hence the fossil is outside the range of the mean $\pm$ 3σ, and therefore is almost certainly not *T. curvirostre*.

According to Ridgway (1907. *Bull. U.S. Natl. Mus.* 50, No. 4:191–199), the related species, *T. longirostre* and *T. ocellatum*, have tarsometatarsi which average 2.3 and 3.8 mm., respectively, longer than those of *T. curvirostre* (measurements taken from skins). Since the latter difference more closely approximates the difference between the length of the fossil and the mean of Engels' series (3.1 mm.), the fossil is tentatively referred to *T. ocellatum*, until an adequate series of skeletons of *T. ocellatum* and *T. longirostre* can be examined.—Robert W. Storer, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan, February 26, 1954.*

A new nesting locality for the Common Tern.—On July 18, 1953, I visited a rock pile at the southern end of Cayuga Lake at Ithaca, New York. This rock pile was part of an old breakwater, running for a distance of about 75 feet at right angles to the wall at Cayuga Inlet, but disconnected from the latter by several feet. The pile, now a jumble of rocks and small boulders, rises only a few inches above water level. There are a couple of small patches of vegetation, but the pile is essentially an open "rock beach" with some debris washed up on it. The pile cannot be reached by walking since the nearest land, a couple of hundred feet away, is the mud flat of the southern end of Cayuga Lake. Thus this rock pile is surrounded by water; it is relatively isolated from dogs and rats, and is not often visited by humans.

As I moored my boat two Common Terns (*Sterna hirundo*) circled and screamed a few feet over my head, and soon one of them started diving at me. Just a few steps from my boat was a tern nest containing two warm eggs. This is the first nesting record of the Common Tern in the southern Cayuga Basin.

On July 23, I revisited the site and found another tern nest, with three warm eggs, on a second island in the same old breakwater. On July 24, Arthur A. Allen visited this little tern colony. He took pictures of the eggs and the incubating bird at the second nest and found that the two eggs of the first nest had been washed away. On July 30, a group of Cornell students found the three eggs still there and warm, but one egg, with a well-developed embryo, was badly cracked. The morning of August 4 I found an adult still incubating the two eggs.

On August 8, Arnold Wellwood visited the tern nest and found that the eggs were cold. Other students visited the spot in the next few days and also reported the eggs cold. On August 23 I went to collect the eggs but found them gone. The nest had been washed over by the waves.

Up to 1953, the nearest records for Common Tern colonies were Oneida Lake, which is on the southwest end of Henderson's Bay (Jefferson County) on Lake Ontario, and Sandy Point, near Lake Ontario. There has been strong evidence that Common Terns occasionally nest at the Montezuma Marsh, at the north end of Cayuga Lake, but as far as is known the first actual nest for the Marsh was found on June 30, 1953, by Oliver Hewitt. There has also been considerable evidence that terns have nested in recent years on an island at the north end of Cayuga Lake, but no nest has been found there.—Mary P. Sherwood, *Department of Conservation, Cornell University, Ithaca, New York, October 5, 1953.*

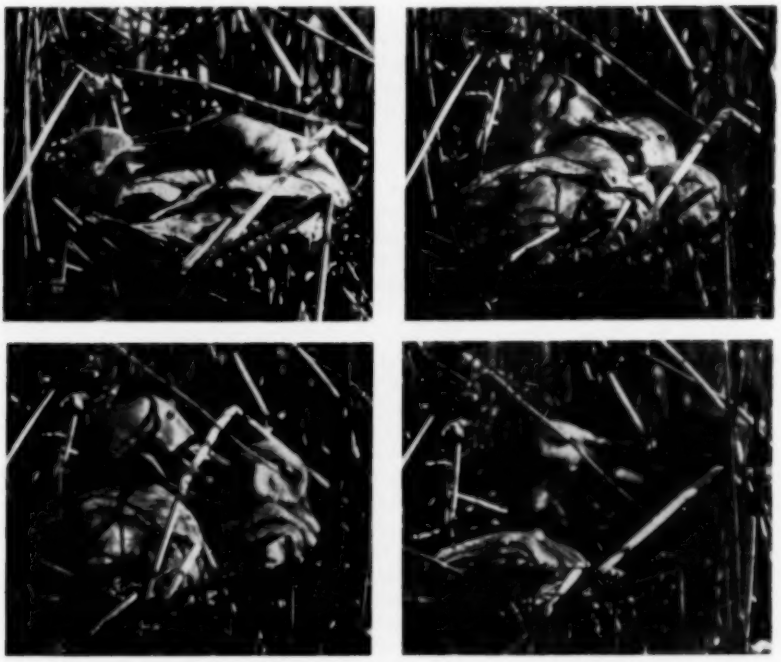
Vertical migration in certain fringillids.— For two summers, while employed as a ranger at Shenandoah National Park in northern Virginia, I have been able to observe birds from late June until early September. The Park embraces a stretch 75 miles long in the Blue Ridge Mountains, rising from approximately 600 feet in elevation in the Shenandoah Valley to 4049 feet at the highest point, Hawksbill Mountain. Some 200 species and subspecies of birds have been recorded in the Park (Alexander Wetmore, "The List of Birds of the Shenandoah National Park," Shenandoah Natural History Association, Bulletin 1, 26 pp., September, 1950, *and* Supplement, 2 pp., August, 1952.) The observations reported here were made mostly at Hughes River Gap, a point 3100 feet in elevation, on the ridge astride the Madison-Page county line and traversed by the well-traveled Skyline Drive.

Many birds occur at Hughes River Gap with some regularity. The Rose-breasted Grosbeak (*Pheucticus ludovicianus*), a summer resident from May 9 to October 2 (dates of residence are from Wetmore, *op. cit.*), is found chiefly above 3000 feet. The Red-eyed Towhee, (*Pipilo erythrophthalmus*), resident from March 27 to October 23, is common at the Gap. The Field Sparrow (*Spizella pusilla*) is common in summer and some winter at the lower levels. The Slate-colored Junco (*Junco hyemalis*) is a permanent resident, mostly above 2500 feet in summer although in winter it may descend to the valley. All of these species breed in the vicinity of the Gap.

Aside from certain altitudinal movements associated with the seasons, as mentioned above, a peculiar sort of movement was noticed among two species common at the Gap, the Indigo Bunting (*Passerina cyanea*) and the Eastern Goldfinch (*Spinus tristis*). The bunting is a common summer resident in the Park from May 9 to September 7, while the goldfinch is resident the year around, being common from late April to early November and irregular through the winter. At the Gap, Indigo Buntings were common in early summer; juveniles, well able to fly, were noted here on July 24. But the species was last seen at the Gap on August 2 both in 1952 and in 1953. The Indigo Buntings from the Gap seemed to retreat to deeper woods and bogs at lower levels. The goldfinch, however, was seen rarely at the Gap in the early summer (only on July 12, 23 and 31, 1953), but was observed, often in flocks of a dozen or so, almost daily throughout August in both years. On August 22, 1953, a goldfinch was singing lustily from a perch atop a white pine which had been similarly used by a bunting in late July. There seemed to be a peculiar reciprocal nature to the presence of these two species at the Gap. That they were mutually exclusive because of competition for food is difficult to believe. Perhaps the situation is traceable to the late breeding habits of the goldfinches.—RICHARD H. MANVILLE, *Department of Zoology, Michigan State College, East Lansing, Michigan, October 13, 1953.*

An observation on Redhead parasitism.—The semi-parasitic nesting habits of many ducks—and especially the Redhead (*Aythya americana*)—are well known (Friedmann, 1932. *Proc. U.S. Natl. Mus.*, 80:1-7). While normal Redhead nests may be found, the species is notorious for its "dump nests." Thus the nests of Canvas-backs (*Aythya valisineria*) and other species may be found containing 20 or more Redhead eggs. Low (1945. *Ecol. Monogr.*, 15:47) suggests that "dumping" occurs either before the Redheads have constructed their nests or after an early nesting failure.

Hochbaum (1944. "The Canvasback on a Prairie Marsh," p. 91) says: ". . . parasitic females probably drop their eggs in the nests of other species during the absences of the owner at this time" (during the egg-laying period). He also states (*op. cit.*:93) that "There is no evidence of severe friction between nesting hens, except in instances of



Top left—Redhead has pushed on to the nest and sits with closed eye while being pecked on the head by the Canvas-back. *Top right*—the Canvas-back and Redhead sit quietly on the nest side by side during a brief pause in their struggles. *Bottom left*—the Canvas-back pecking at the Redhead's head. *Bottom right*—Redhead leaves the nest, still being pecked by the owner.

parasitic intrusions . . ." The following observation provides an instance of a Redhead laying in a Canvas-back nest while the owner was present.

On May 25, 1952, the nest of a Canvas-back was found at Delta, Manitoba. This nest contained 8 eggs which subsequently hatched successfully on June 20. At the end of May, a blind was erected some distance from the nest and gradually moved closer. Although the duck was nervous at first, it soon became possible to watch her normal behavior on the nest from a distance of about 15 feet.

On the afternoon of June 18, the Canvas-back had been observed incubating normally for about 2 hours when suddenly a female Redhead appeared at the side of the nest and pushed her way on to it. The owner reacted immediately by pecking vigorously at the Redhead's head, but the latter merely eased herself further on to the eggs and did not attempt to retaliate. The two birds remained sitting side by side for a period of 4–5 minutes. The Redhead appeared rather sleepy or dazed and frequently closed her eyes. This may have been due partly to the rain of blows which the Canvas-back delivered at her head. After the birds had changed position once or twice while struggling, the Redhead rose from the eggs and moved off the nest, and the owner returned to normal incubation.

When the Canvas-back was flushed some time later, a fresh Redhead egg was found in the nest.

Although this is an isolated observation, the fact that successful egg-dumping was achieved while the owner remained on the nest suggests that this may be a normal technique adopted by Redheads.—D. F. McKINNEY, *Severn Wildfowl Trust, Slimbridge, Gloucestershire, England, October 14, 1953.*

Diurnal foraging by the Great Horned Owl.—Diurnal foraging by the Great Horned Owl (*Bubo virginianus*) has been noted by various workers. Bent (1938. *U.S. Natl. Mus. Bull.*, 170:312), for example, reports observations made in the middle of the day of these owls soaring like large hawks. While doing field work in August, 1953, in the Riverside Mountains of California, a desert range bordering the west side of the Colorado River approximately 35 miles north of Blythe, Riverside County, I was impressed by the diurnal activity of the Great Horned Owl. On many occasions, while hiking up canyons of the east slope of the range in late afternoon, I observed owls that seemed to be foraging. I watched one individual with binoculars for a short time, and saw it perch on several commanding outcrops of rock on the steep walls of the canyon, staying approximately a minute at each vantage point. The time was more than an hour before sundown and the rims of the canyons were in sunlight, although the canyon in which the owl was noted was in deep shadow. Indirect evidence was obtained indicating that Great Horned Owls foraged in this area even in full daylight. In a large grotto, from which an owl had repeatedly been flushed, I discovered in weathered owl pellets the nearly complete skull of a chuckwalla (*Sauromalus obesus*), a large iguanid lizard active only during the hottest part of the day. To catch this chuckwalla the horned owl probably foraged in the sunlight. The following species also were taken from the owl pellets: pallid bat (*Antrozous pallidus*), pocket mouse (*Perognathus formosus*), kangaroo rat (*Dipodomys merriami*), wood rat (*Neotoma lepida*), and cottontail (*Sylvilagus audubonii*).

Evidence from trapping small mammals suggested a possible explanation for the diurnal activity of horned owls in this area. Rodent activity was low in the Riverside Mountains area when these observations were made and the rodents foraged mostly in early morning. Consequently the horned owls may have been unable to obtain sufficent food during their usual nocturnal hunting, and of necessity may have extended their foraging into the daylight hours.—TERRY A. VAUGHAN, *Museum of Natural History, University of Kansas, Lawrence, December 30, 1953.*

American Bittern in Virgin Islands.—One of the rewards of living on a small, isolated sea island is the thrill of discovering, now and again, a new inhabitant. On the morning of October 7, 1953, I flushed a tall, buff-colored bird in a partly overgrown cow pasture at Estate Anguilla, St. Croix, Virgin Islands. At first I thought it was a young night heron. Something about this bird, however, did not appear right so I collected it. It was an American Bittern (*Botaurus lentiginosus*). The only bittern ordinarily found in the Virgin Islands is the Least Bittern (*Ixobrychus exilis*), and this is very uncommon. The closest point from which American Bitterns have been previously recorded is the island of Puerto Rico, 80 miles to the northwest. This bird was prepared as a skin; it measured as follows: wing, 255 mm.; tail, 85 mm.; bill, 66 mm.; tarsus, 85 mm. The stomach was practically empty. The bird was very light, but appeared to be in sound condition. No ectoparasites were found.—GEORGE A. SEAMAN, *Wildlife Biologist, Christiansted, St. Croix, Virgin Islands, October 16, 1953.*

A second flock of Whooping Cranes.—On March 20, 1952, I was seeking to study the Lesser Prairie Chicken (*Tympanuchus pallidicinctus*) about ten miles southeast of Arnett, Ellis County, Oklahoma. It was a beautiful spring day, with clear sky and balmy temperature. From time to time another and yet another flock of Sandhill Cranes (*Grus canadensis*) would fly past, all going practically due north. About 4 p.m. a flock of at least 200 Sandhill Cranes flew directly over my head, "bugling" loudly. I glanced at the flock then, but did not notice any as being different from the others in this brief belly view.

When this flock was between a quarter and half a mile north of me, it evidently encountered a thermal, because it began an upward spiral. This maneuver is common among cranes. When the flock was at the east side of the circle, I noticed a gleam of white at one edge of the flock, and focussed my 8 × 30 binoculars on it. The sun shone on half a dozen snowy white birds, with sharply marked black primaries. My observations totalled at least a minute with good focus.

For an instant I thought there must be White Pelicans (*Pelecanus erythrorhynchos*) in the flock. But pelicans flap and coast . . . these birds flew like all the other cranes, with steady beats and a curious quick upward flip of the wings each time. Their long legs trailed behind, their long necks stretched out in front. They, too, were cranes.

Two days later I went down to the Aransas Wildlife Refuge in Texas where the Whooping Cranes (*Grus americana*) winter. One of the assistants to whom I talked did indeed think that some of theirs might have started north, and been the ones I saw. But the director, Mr. Julian Howard, wrote to me that still later counts revealed that all of their Whooping Cranes were still in Texas at that time. He also said that he had a number of other records of a possible additional small flock of Whooping Cranes, presumably wintering in Mexico, but all the other records were more questionable than mine.

Having collected birds and prepared skins, I am well aware of the lack of certainty involved in all sight records. The present record, however, is based upon birds of such conspicuous marking that it is worthy of notice.—Max W. deLaubenfels, *Department of Zoology, Oregon State College, Corvallis, Oregon, April 23, 1953.*

[See Robinson, 1953, *Wilson Bull.*, 65:211, for a sight record of a Whooping Crane in south-central Kansas on March 23, 1952. It seems probable that this record might pertain to one of the birds reported by Prof. deLaubenfels.—Ed.]

Additional notes on the birds of southwestern Kansas.—In the fall of 1952, Richard R. Graber and I visited Morton County, Kansas for three days, September 2–5. Among the birds that we collected were two species not heretofore reported from Kansas and several not reported in the fall. We made most of our observations in a large grove of cottonwoods along the Cimarron River about 8 miles south of Richfield, and about 6 miles east of Kansas highway 27.

Since there are no published accounts of early fall migration in western Kansas, I have included in the following list, species of especial interest as far as distribution or migration are concerned. It is not, however, a complete list of species encountered.

I am grateful to Dr. George Attwood of the U. S. Soil Conservation Station, Elkhart, Kansas, for permission to collect in the area. I wish to thank Dr. Allan R. Phillips for identifying specimens and Dr. George M. Sutton for the use of his collection.

Stellula calliope. Calliope Hummingbird.—While I did not see a single hummingbird in four months of field work in the spring of 1950, on September 3 I saw and collected an immature female (RRG 1807) which measured: exposed culmen, 14; wing, 45; tail, 24

millimeters. The dorsum is bronze-green, and the flight feathers dark gray. The sides, belly, undertail coverts, and flanks are buffy. The feathers of the throat have a median spotting of dusky brown. The auriculars are light gray. The tail has subspatulate rectrices with a relatively large amount of terminal white on the outer three. The white on the third rectrix is equally distributed on the inner and outer webs. The median pair of rectrices are bronze-green with blackish tips. The next three pairs of lateral rectrices have narrow, but distinct, edgings of cinnamon-buff, sub-basally on both webs.

At the 1952 A.O.U. Meeting, Dr. Allan R. Phillips tentatively identified (without aid of comparative material) the specimen as *Stellula calliope*. I have subsequently compared it with similar species. On the basis of size, it is separable from the Black-chinned Hummingbird (*Archilochus alexandri*) and the Broad-tailed Hummingbird (*Selasphorus platycercus*). It differs from the Rufous Hummingbird (*Selasphorus rufus*) in that the middle pair of rectrices in the latter are broadly edged on inner and outer webs with cinnamon-buff.

My specimen is readily separable from fall female Ruby-throated Hummingbirds (*Archilochus colubris*) in that the auriculars of the latter are darker, the flight feathers narrower, the rectrices narrower at the tips, there are no cinnamon-buff edgings on the webs of any rectrices, and the white on the third rectrix is confined more or less to the inner web.

I have taken space to point out the distinguishing characters in order to emphasize the difficulty of identifying fall specimens of female and immature hummingbirds. Field identification of this group in western Kansas is completely unreliable, and until there is a better knowledge of the hummingbirds which occur there, all should be collected.

Dendrocopos scalaris symplectus. Ladder-backed Woodpecker.—This species appears to be the commonest woodpecker after the Flicker (*Colaptes* species) along the Cimarron in Morton County. I noted it daily and R. Graber collected a female which is referable to *symplectus*.

Tyrannus vociferans. Cassin's Kingbird.—I noted this species but once, a single bird on September 5. It perched on weed stalks on the prairie overlooking the Cimarron.

Empidonax difficilis. Western Flycatcher.—I saw two or three *Empidonax* daily, and collected the yellowest bird I saw on September 3. It was an immature female (RRG 1804) which measured: exposed culmen, 11; wing, 68; tail, 59 millimeters. On September 5, R. Graber collected an immature male (RRG 1817) measuring: exposed culmen, 12; wing, 70; tail 62 millimeters. In both specimens, the tenth primary is shorter than the fifth. The wing bars are distinctly buffy. Allan R. Phillips identified the female as belonging to the subspecies *hellmayri*, and the male as intermediate between *difficilis* and *hellmayri*. These are the first Kansas records of the Western Flycatcher.

Vireo solitarius. Solitary Vireo.—The species was encountered but twice. R. Graber collected an immature female referable to the race *plumbeus*, an September 3. On the same date I collected an immature female of the drab, olive-gray form *cassini*. These are the first fall records of these forms in Kansas.

Dendroica townsendi. Townsend's Warbler.—Single birds were seen September 3 and 5. I collected the latter, an immature female (RRG 1816). This is the first fall record for the species in Kansas. It may be more common as a fall than as a spring migrant, since during the entire spring of 1950 only three were seen (Graber, 1950, *Wilson Bull.*, 62:208).

Seiurus aurocapillus. Oven-bird.—Single birds seen September 4 (female collected) and 5. The specimen compares well with a series of the nominate race but has a very pale crown.

Seiurus motacilla. Louisiana Water-thrush.—I saw one on September 5. Long (1940. *Trans. Kansas Acad. Sci.*, 43:451) indicated that eastern Kansas is the western limit of this species' range. It actually occurs in small numbers in both spring (Graber, 1951. *Trans. Kansas Acad. Sci.*, 54:166) and fall in extreme southwestern Kansas.

Setophaga ruticilla. American Redstart.—A female was seen September 3.

Piranga ludoviciana. Western Tanager.—I collected an immature female (RRG 1813) on September 4. This is apparently the third specimen for Kansas.—JEAN W. GRABER, *Dept. of Zoology, University of Oklahoma, Norman, Oklahoma, February 1, 1953.*

Black-throated Sparrow in Kansas.—On the morning of November 25, 1952, three miles east and four miles north of Garden City, Kansas, I noticed a small sparrow among the rafters of my garage. I had on previous occasions noted creepers, kinglets, and English Sparrows *(Passer domesticus)* in the garage but this bird I did not recognize so I closed the door for closer observation. After tentatively identifying it as a Black-throated Sparrow *(Amphispiza bilineata)*, I decided to capture it for positive identification and the bird was killed in the process. A check of the literature revealed no known records of this bird in Kansas. The prepared skin was sent to the Museum of Natural History at the University of Kansas where H. B. Tordoff identified it as *A. b. deserticola.* The specimen is now No. 31356 in the collection at the University of Kansas, Lawrence, Kansas.—MARVIN D. SCHWILLING, *Kansas Forestry, Fish and Game Commission, Box 864, Garden City, Kansas, September 17, 1953.*

Summer records of Redheads in a Michigan inland marsh.—Wood's "Birds of Michigan" (1951. *Univ. Mich. Misc. Publ., Mus. Zool.*, No. 75) includes bird records through 1943. Nine Redhead (*Aythya americana*) nesting records are given for Michigan, only two of which occurred in the last forty years. These nests were found in Saginaw Bay by H. J. Miller on May 28, 1941, one on Lone Tree Island, Huron County, and the other at Fish Point, Tuscola County. None of the reported nesting sites are in inland marshes (away from the Great Lakes). Three records of adults in summer are given by Wood in addition to the nesting records.

Thirteen miles southwest from Saginaw Bay near the Saginaw River lies a 1200 acre marsh. It is surrounded by an artificial dike. The depth of the water in this marsh is regulated by a pumping system. This area was formed from low lying farm land about 1919 and was known as the Oneida Fur Farm. It is now a breeding and migration stopover place for many water birds and in 1953 was made a state wildlife sanctuary.

Summer month observations of this marsh during years 1948 through 1953 resulted in the following records of Redheads: June 26 and July 24, 1948, 1 female (E. E. Kenaga); June 17, 1950, 30 males and females, nest with eggs (E.E.K. and M.A. Wolf); July 23, 1950, 1 male, also 1 female with young (E.E.K.); August 5, 1950, 1 male (E.E.K.); June 10, 1951, 8 males, 8 females (E.E.K.); June 30, 1951, 6 males, 6 females (E.E.K.); July 21, 1951, 1 female (E.E.K.); Summer, 1951, 3 young (F.O. Novy, J. Fitzgerald); July 9, 1952, nest with eggs, 1 female (F.O.N.); June 22, 1953, nest with 8 eggs, 1 female (F.O.N.); July 4, 1953, 1 female and 7 young (E.E.K. and M. Pirnie); July 14, 1953, nest with 8 eggs, 1 female (F.O.N.); August 23, 1953, 6 young (F.O.N.). (Also see G. Wickstrom, 1953. *Jack-Pine Warbler*, 31:142.)

These observations are apparently the first records of inland nesting of the Redhead in Michigan and add to the number of summer records of adults of this species.—E. E. KENAGA, *1629 Isabella Road, Route 5, Midland, Michigan, January 7, 1953.*

Notes on the call of a Ferruginous Pigmy Owl.—In May and June, 1949, we recorded on magnetic sound tape a call of a Ferruginous Pigmy Owl (*Glaucidium brasilianum*). The recordings were obtained in the Santa Ana Wildlife Refuge, located some 30 miles west of Harlingen, Texas. L. Irby Davis indicated that our records furnished the first positive proof that the bird inhabited this Refuge. In our work we were aided materially by Luther Goldman, the Refuge director. The refuge tract lies between a flood dyke and the Rio Grande and, excepting some flood-filled lakes, is densely timbered; the trees are festooned with vines and Spanish moss and are almost impenetrable in many places because of the heavy undergrowth of thorny shrubs. Our recorder was located about one-half mile from the northern edge of the tract on a partially-cleared neck of land between two of the lakes. One microphone was close by, with another about 500 feet to the south in dense vegetation; at that point, the Rio Grande was about a mile and a half farther south.

Our attention was first called to the owl while reviewing an earlier recording, obtained about 4:30 a.m. The owl must have been at a considerable distance from the microphone; using the greatest play-back volume obtainable, a faint, frog-like sound was heard, a single short note repeated at a uniform rate. On our next visit, the bird called from a tree rather close to the recorder; it was still dark, and we were not able to see the bird on his perch; after calling for a minute or so, a brief glimpse was obtained against the sky as he flew south. Immediately we picked him up on the distant microphone; after calling for a minute or so near that location, there was a brief silence; then the call again, quite faint; then silence, and we heard the bird no more.

During its performance, the owl gave the call at a rate of about 150 repetitions per minute; this rate was maintained throughout our recordings. The call would be repeated a varying number of times, ranging from 10 to 45 repetitions; then the bird would pause for about 10 seconds, and again begin the call. Subsequently, through the courtesy of Dr. P. P. Kellogg of Cornell University, we were privileged to hear the call of another Ferruginous Pigmy Owl, recorded some years previously on a phonograph record by Dr. A. A. Allen in Mexico. For all practical purposes, the recordings are identical with respect to quality, pitch, and time intervals.

Published "oral" descriptions of the call differ appreciably, possibly because of a difference in individual birds, but more likely because the call sounds differently to different observers. A. C. Bent, in his "Life Histories" (*U. S. Natl. Mus. Bull.* 170:437–438) quoting others, gives brief descriptions of the call: to Bendire, it sounded like *chu*; to Euler, like *khiu*; and to Stephens, like *cuck*. Peterson (1941. "A Field Guide to Western Birds," p. 90) adds one from Sutton: *chook* or *took*.

In the recordings of our bird, we are not able to detect with certainty either the "c" "k," or "t" sounds indicated above. The quality is not shrill nor sibilant; rather, it is clear and mellow, something like *whah* (short "a" as in "ah"), with the sound originating well back in the mouth, not near the teeth. By puffing, or "whuffing" the breath across the opening of a bottle, partially filled with water, we were able to produce a note resembling the call of this owl, both in quality and in pitch. Using a pitch pipe, we estimate the tone as F sharp in the third octave above middle C on the piano, close to 1400 cycles per second.—Jerry and Norma Stillwell, *RFD #2, Fayetteville, Arkansas, January 22, 1954.*

A nest of the Yellow Warbler superimposed on a Red-eyed Vireo nest.—On June 6, 1953, while collecting nesting data in Rondeau Park, Canada, I found the nest of a Yellow Warbler (*Dendroica petechia*) superimposed on the nest of a Red-eyed

Vireo (*Vireo olivaceus*). The nests were in a horizontal fork of a beech tree (*Fagus grandifolia*) suspended between two small branchlets, 93 inches above the ground. The area in which the nests were found represented a small cut-over section of a surrounding virgin beech-maple forest. This type of habitat may be considered typical for the Red-eyed Vireo but somewhat different from the habitat in which the Yellow Warbler usually nests.

Upon discovery, the female Yellow Warbler flushed from the nest and was joined in a nearby tree by the male after she had uttered alarm notes. The nest was collected and the following data obtained: The completed vireo's nest contained two Cowbird's (*Molothrus ater*) eggs which probably had been abandoned before the warbler's nest was started. The warbler's nest was built inside the cup of the vireo's nest and firmly attached to the materials at the rim of the vireo's nest, making what appeared at first glance to be a semi-pensile nest of the warbler. The finished nest of the Yellow Warbler also contained two eggs of the Cowbird, apparently laid by different females since the markings of the two eggs were decidedly different. The Cowbird eggs were covered by a second lining on which the female Yellow Warbler was incubating two eggs of her own. The measurements of the nest were: total height, 68 mm.; height of vireo's nest, 32 mm.; height of warbler's nest, 36 mm.; inside diameter of warbler's nest, 33 mm.; outside diameter of warbler's nest, 44 mm.; inside depth of warbler's nest, 31 mm.

These observations were confirmed by Douglas S. Middleton and Walter P. Nickell at the time the nest was discovered.—Harold D. Mahan, *582 E. Drayton Avenue, Ferndale, Michigan, August 24, 1953.*

Cardinal's period of dependency.—A female Cardinal (*Richmondena cardinalis*) that hatched July 25, 1953, and was color-banded before it left the nest August 4, was next seen when it began coming to my feeding shelf with its parents on September 5. This juvenile was fed regularly through September 7, on that same day began to eat raisins and crumbs of seed kernels for itself, was still fed occasionally through September 12, first succeeded in opening its own sunflower seeds September 20, begged rarely as late as September 26, and was last seen with a parent October 2. That is partial independence at the age of 44 days, complete independence at 50 days, and severance of family ties at 70 days; these figures are even higher than those I found for two other juveniles (1944. *Wilson Bull.*, 56:173–174). This bird was a member of the third and last brood of a color-banded pair, and the only member that survived the age of three weeks. —Hervey Brackbill, *4608 Springdale Avenue, Baltimore 7, Maryland, December 10, 1953.*

The Aves section of the *Zoological Record* covering the ornithological literature of 1952 was issued in March, 1954. Again we acknowledge our indebtedness to Lt. Col. W. P. C. Tenison for so ably preparing this essential bibliography and we urge our readers to support this publication, which is available for seven shillings and sixpence from The Zoological Society of London.

ORNITHOLOGICAL LITERATURE

ANNUAL CYCLE, ENVIRONMENT, AND EVOLUTION IN THE HAWAIIAN HONEYCREEPERS (AVES: DREPANIIDAE). By Paul H. Baldwin. University of California Publications in Zoology, Volume 52, Number 4, October 28, 1953: pp. 285–398, pls. 8–11, figs. 1–12. 6¾ × 10¼ in. $1.50.

Here is a study, complementary to that by Amadon (1950. *Bull. Amer. Mus. Nat. Hist.*, 95:151–262), which places us another step ahead in our understanding of a most fascinating group. This author has, in principle, accepted and followed Amadon's taxonomic revision of the Drepaniidae. With only passing mention of most forms, he has concentrated on a comparative ecological study of certain species which still persist in numbers.

Baldwin spent extended periods in and near the Hawaiian forests over a span of twelve years, 1937 to 1949. It is evident that prior to his final year of intensive work there was opportunity, not only to gather a great many preliminary and corroboratory data, but to plan carefully the several lines of later investigation. The resulting study impresses this reader as unusually coherent. Although acquainted with 13 forms of living drepaniids, Baldwin confined his efforts largely to 3: *Vestiaria coccinea*, *Himatione sanguinea sanguinea*, and *Loxops virens virens*, all of which are still numerous in the Hawaii National Forest and elsewhere. Study plots were established at various elevations on the volcano slopes, mostly within the park. Local temperature and rainfall measurements, studies of vegetation types, censuses of bird populations, checks on the bloom of flowering trees, collections of tree-inhabiting invertebrates, and special observations on the three honeycreeper species mainly concerned, were carried on more or less concurrently along the transect formed by the plots. Numerous specimens were collected at intervals during the same period, from the forests closely adjacent, for study of molt, weight changes, gonadal cycles, skull development, and stomach contents.

Some new interpretations of molt-sequence are presented (see also Baldwin, 1952. *Auk*, 69:92–98), the result of very thorough and systematic comparisons. A number of interesting ideas on adaptation and past evolution within the family are evolved from the analyses of present-day factors. The main contribution, however, is the discussion of the three species as living populations: their territorial behavior, breeding cycles, habitat preference, utilization of nectar and of animal food, seasonal movements, and adaptation to the island environment in general. This is stimulating and refreshing; it is encouraging that studies not made when the Hawaiian honeycreepers were at their peak of abundance, can yet be accomplished for at least a few species that are holding their own. The close relationship between the birds and the flowering trees *Sophora* and *Metrosideros*, though long an accepted fact, is here discussed in concrete terms. It is disturbing to note that two of the three species of birds showed a decrease in numbers during the total period of the investigations, and that it could be correlated in part with the spread of the introduced white-eye (*Zosterops*) in the area. A glance at the census figures shows at once the extent to which various exotic species have invaded even these relatively remote forests: they represent exactly half of the 22 species recorded on the plots.

Some might take issue with the suggestion that color and pattern in the drepaniids are largely nonadaptive (a point upon which the author himself seems to have rather divided feelings), while song (as a social releaser) is conceded to be, in a sense, adaptive. Momentary annoyance may be caused by such laxities as the continued use of "juvenal" as a noun, and repeated lumping of spiders and mites with "insects." But all of the factual material and analyses appear to be sound, and the inferences, in the main, well

founded. The whole work is attractive and readable, the photographs good, the graphs and tables clear, and the typographical errors very few. From many points of view, the paper is well worth a reader's perusal.—WILLIAM A. LUNK.

LAND USE AND OUR AVIFAUNA

A contribution from the Wilson Ornithological Club Conservation Committee

American ornithologists have enjoyed a luxury impossible in long settled countries. We came upon a continent in which the fauna and flora were practically unaltered by man. We have had the opportunity to observe and study birds in virtually primeval conditions, and though we have lost some species by the settlement of the country, we still have available some wilderness with its original inhabitants.

It must be generally accepted now that our conservation efforts rest on land use planning. A striking problem of this kind is the future of our sage grouse. They are fairly plentiful in the western plains and are hunted as a game bird, and as you drive through the miles of sage country, it may seem that they are safe enough.

But big things are happening. There is a program of sage elimination using herbicides from airplanes. I have seen large areas treated in this way, for the purpose of encouraging grass free from competition of sage. Furthermore, the reclamation program is putting large sage areas under irrigation and hence cultivation. If the sage goes, the sage grouse go, for these birds are essentially browsers and depend on sage leaves for winter survival. Dr. Robert Patterson's exhaustive study of the stage grouse (1952. "The Sage Grouse in Wyoming," Wyoming Game and Fish Commission), clearly outlines the survival requirements of this bird and suggests an economy pattern for certain western areas that would insure the survival of the species.

Nearly 20 years ago, with several associates, I had opportunity to study the fauna of the Aleutian Islands, on behalf of the U.S. Fish and Wildlife Service. We found that some cackling geese still nested on a few of the islands, but the big migration that used to come east and south from the Aleutians was nearly ended. Part of the destruction may have been by extensive shooting in autumn in the Pacific Coast states. But another vital reason was the fact that most of the islands had been leased for blue fox farming. Foxes were simply turned loose to multiply, and were trapped occasionally for the market. We recommended that Agattu Island, especially, and several others which contained good breeding areas, should be cleared of all blue foxes, in the hope that the remnant of this goose population, and the *migration to* and *from* the Aleutians, might be saved. Then came the war, and I do not know whether the foxes were ever removed.

We need to give serious attention to the problem of land use. To survive, an animal must have a place to live. There is today a hopeful movement to preserve areas in the original state. We have a system of national parks and wilderness areas. And the Nature Conservancy is concerned with preserving the smaller natural areas. There are state parks and wildlife refuges. As was stressed at one of the discussions of the Mid-Century Conference on Resources for the Future at Washington last December, this whole system needs expansion.

But we are having great difficulty in retaining what we have. As these lines are written there is a proposal in Congress to include Echo Park dam in Dinosaur National Monument in the program for water development in Utah and Colorado, and we know that the dam builders have designs on Glacier National Park and that the lumbermen

want a big slice of Olympic National Park. We are still so board-feet-minded as a nation we are having trouble keeping our wilderness areas on national forests intact.

Overshadowing all this is the present concerted move to do away with public lands in a big way. On a national scale there have been bitter fights over certain bills in Congress, and more are on the way. The operation of the present mining regulations has become a national scandal, removing, by various subterfuges, thousands of acres from government ownership. The way we are crowding the Pacific salmon into oblivion is indication of what can happen when certain financial interests invoke the sacred formula "the national economy" or "the local economy," to gain their ends.

Here, in the struggle for public land—to seize it versus to keep it—is the arena for modern conservation. Each citizen, whether a scientist or not, can serve by associating with his favorite conservation organization so as to be informed on the issues as they confront us—and then act.

We believe there are enough people who are sympathetic to conservation objectives, or would be if they knew. The problem is to reach them, and to have it understood that all must take part individually as each crisis arises.—OLAUS J. MURIE.

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SUGGESTIONS TO AUTHORS

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A WORD TO MEMBERS

The Wilson Bulletin is not as large as we want it to be. It will become larger as funds for publication increase. The Club loses money, and the size of the *Bulletin* is cut down accordingly, each time a member fails to pay dues and is put on the 'suspended list.' Postage is used in notifying the publisher of this suspension. More postage is used in notifying the member and urging him to pay his dues. When he does finally pay he must be reinstated on the mailing list and there is a publisher's charge for this service. The *Bulletin* will become larger if members will make a point of paying their dues promptly.

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